

NUCLEAR SCIENCE ABSTRACTS

Vol. 8, No. 7, April 15, 1954

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Laboratories and Equipment	1838		Measuring Instruments and Techniques		1959
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Radiation Effects	1840		Molecular Properties		1990
Rare Earths and Rare-earth Compounds	1842		Neutrons		1991
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CALENDAR OF MEETINGS

Suggestions for additions to this list will be welcomed and should be sent with all pertinent information to the Cataloging Branch, Technical Information Service, U. S. Atomic Energy Commission, P. O. Box 62, Oak Ridge, Tennessee.

June 20-25, 1954

NUCLEAR ENGINEERING CONFERENCE, University of Michigan, Ann Arbor, Michigan, Sponsored by: American Institute of Chemical Engineers.

Inquiries should be addressed to: Professor Donald Katz, University of Michigan, Department of Engineering, Ann Arbor, Michigan.

July 19-24, 1954

SECOND RADIOISOTOPE CONFERENCE (a conference on the peaceful uses of atomic energy), Oxford, England,

Arranged by: The Atomic Energy Research Establishment, Harwell.

Inquiries should be addressed to: The Conference Secretary, Atomic Energy Research Establishment, Harwell, Didcot, Berks, England.

SELECTED SUBJECTS OF INTEREST TO INDUSTRY

All AEC reports abstracted in this issue of **Nuclear Science Abstracts** have been reviewed and evaluated in terms of their interest and usefulness to general industry. These reports are listed below by title, author, and report number under one or more of the following nine broad categories: Chemistry and Chemical Engineering; Construction and Civil Engineering; Electronics and Electrical Engineering; Health and Safety; Industrial Management; Mechanics and Mechanical Engineering; Metallurgy and Ceramics; Mining and Geology; and Nuclear Technology. The abstract number for each report is listed at the upper right of the entry and refers to an item in the current issue of NSA.

All unclassified reports considered to be of special interest to general industry issued by the AEC prior to July, 1953 are listed or abstracted in a series of bibliographies (TID-3050), the titles of which correspond to the above-mentioned categories. As these background bibliographies become available for sale, the prices will appear in the Numerical Index of Reports which is included in each issue of this volume of NSA. These bibliographies may be purchased from the U. S. Department of Commerce, Office of Technical Services, Washington 25, D. C.

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CHEMISTRY AND CHEMICAL ENGINEERING

AECU-2794

1875

Stanford Univ. School of Mineral Sciences
INVESTIGATION OF MATERIALS FOR USE IN A HEAT
TRANSFER SYSTEM CONTAINING LIQUID LEAD OR
BISMUTH. O. Cutler Shepard, James R. Morgan, Ralph
Parkman, and Richard D. Seibel. Dec. 31, 1953. 41p.
Contract AT(11-1)-190, Report No. 15. (AECU-2794)

AECU-2798

1947

Institute of Engineering Research, Univ. of Calif., Berkeley
ORIFICE METERING COEFFICIENTS FOR LEAD-
BISMUTH EUTECTIC. H. A. Johnson, J. P. Hartnett,
W. J. Clabaugh, and L. Fried. Dec. 1953. 33p. Contract
AT-11-1-GEN-10, Project 5, Phase II. (AECU-2798)

BNL-1688

1841

Brookhaven National Lab.
GAMMA RAY POLYMERIZATION OF ACRYLAMIDE IN
THE SOLID STATE. Robert B. Mesrobian and Paul Ander,
Polymer Research Inst., Polytechnic Inst. of Brooklyn and
David S. Ballantine and G. J. Dienes, Brookhaven National
Lab. [Jan. 15, 1954]. 6p. (BNL-1688)

HW-29455

1853

Hanford Works
MICROTITRATION OF FREE ACID IN URANYL NITRATE
SOLUTIONS. W. N. Carson, Jr. Oct. 1, 1953. Decl. Jan.
26, 1954. 22p. Contract W-31-109-Eng-52. (HW-29455)

ISC-354

1842

Ames Lab.
CONDUCTANCES AND TRANSFERENCE NUMBERS OF
SOME RARE EARTH PERCHLORATES, SULFATES AND
NITRATES IN AQUEOUS SOLUTION. S. Jaffe and F. H.
Spedding. June 1953. 126p. Contract W-7405-eng-82.
(ISC-354)

ISC-438

1809

Ames Lab.
THE KINETICS OF THE REDUCTION OF PERCHLORATE
ION BY Ti(III) IN DILUTE SOLUTION. Frederick R. Duke
and Paul R. Quinney. Jan. 13, 1954. 15p. Contract W-
7405-eng-82. (ISC-438)

ORNL-1445

1838

Oak Ridge National Lab.
AN IMPROVED FLUOROPHOTOMETER FOR DETERMINA-
TION OF URANIUM IN FUSED SODIUM FLUORIDE PEL-
LETS. M. T. Kelley, H. L. Hemphill, and D. M. Collier.
Feb. 8, 1954. 21p. Contract W-7405-eng-26. (ORNL-1445)

UCRL-2312

1870

Radiation Lab., Univ. of Calif., Berkeley
SOME MEASUREMENTS ON A HIGH-VACUUM HIGH-
SPEED ION PUMP (thesis). John Stuart Foster, Jr. Aug.
17, 1953. 67p. Contract W-7405-eng-48. (UCRL-2312)

CONSTRUCTION AND CIVIL ENGINEERING

ORNL-1666

1858

Oak Ridge National Lab.
SOLID AEROSOL GENERATION. W. D. Cottrell. Feb. 5,
1954. 26p. Contract W-7405-eng-26. (ORNL-1666)

ELECTRONICS AND ELECTRICAL ENGINEERING

LRL-62

1884

Livermore Research Lab., Calif. Research and Development
Co.
THERMOELECTRIC CALIBRATION OF ZIRCONIUM-CON-
STANTAN AND ZIRCONIUM-ALUMEL THERMOCOUPLES.
C. J. Shoens and J. W. Shortall. Issued Dec. 1953. 17p.
Contract AT(11-1)-74. (LRL-62)

ORNL-1656 1857
Oak Ridge National Lab.
ELECTROSTATIC PRECIPITATOR FOR MEASURING
PARTICLE-SIZE DISTRIBUTION IN AEROSOLS. Bernard
G. Saunders. Feb. 8, 1954. 24p. Contract W-7405-eng-
26. (ORNL-1656)

HEALTH AND SAFETY

AECU-2796 1856
Little, Arthur D., Inc.
SURVEY OF AIR SAMPLING MEDIA AND SAMPLING
METHODS USED AT A.E.C. AREAS AND BY OTHERS.
Sept. 1953. 5p. (AECU-2796)

MECHANICS AND MECHANICAL ENGINEERING

KAPL 1001 1883
Knolls Atomic Power Lab.
THERMAL STRESSES IN RECTANGULAR STRIPS. PART
1. G. Horvay and J. S. Born. Oct. 20, 1953. 73p. Con-
tract W-31-109-eng-52. (KAPL-1001)

METALLURGY AND CERAMICS

AECU-2794 1875
Stanford Univ. School of Mineral Sciences
INVESTIGATION OF MATERIALS FOR USE IN A HEAT
TRANSFER SYSTEM CONTAINING LIQUID LEAD OR

BISMUTH. O. Cutler Shepard, James R. Morgan, Ralph
Parkman, and Richard D. Seibel. Dec. 31, 1953. 41p.
Contract AT(11-1)-190, Report No. 15. (AECU-2794)

ANL-5001 1876
Argonne National Lab.
AQUEOUS CORROSION OF 2S ALUMINUM AT ELEVATED
TEMPERATURES. J. E. Draley and W. E. Ruther. Feb. 1,
1953. 41p. Contract W-31-109-Eng-38. (ANL-5001)

COO-189 1881
Armour Research Foundation
PHASE DIAGRAMS OF ZIRCONIUM-BASE BINARY
ALLOYS. REPORT NO. 13. THE ZIRCONIUM-NITROGEN
SYSTEM. REPORT NO. 3. OCTOBER 1, 1953-DECEMBER
31, 1953. R. F. Domagala and D. J. McPherson. Dec. 31,
1953. 11p. Contract AT-(11-1)-149. (COO-189)

HW-30156 1882
Hanford Works
A REPLICA PRESS ATTACHMENT FOR THE PRECISION
MOUNTING PRESS FOR USE IN PREPARING ALUMINUM
REPLICAS OF THE SURFACES OF IRRADIATED MA-
TERIALS. W. E. Roake. Oct. 21, 1953. 15p. Contract
W-31-109-eng-52. (HW-30156)

UCRL-4169 2035
Radiation Lab., Univ. of Calif., Livermore
SPUTTERING OF STAINLESS STEEL BY PROTONS IN
THE 30-80 KEV RANGE. Forrest Fairbrother, Jr. and
John S. Foster, Jr. Aug. 11, 1953. 12p. Contract
W-7405-eng-48. (UCRL-4169)

An asterisk preceding the abstract number indicates that the corresponding report is included in the "Selected Subjects of Interest to Industry" section of this issue.

GENERAL

ATOMIC BOMBS AND WARFARE

1770

CIVIL DEFENSE AND ATOMIC WARFARE; A SELECTED READING LIST. U. S. Atomic Energy Commission, Washington. Superintendent of Documents, 1953. 48p.

This bibliography includes unclassified technical documents prepared by the Atomic Energy Commission and its predecessor agency, the Army's Manhattan Engineer District, as well as selected books and periodical articles covering atomic warfare and civilian defense. (C.H.)

BIOLOGY AND MEDICINE

1771

Brookhaven National Lab.

THE INFLUENCE OF LOW SULFATE NUTRITION ON CHROMOSOME DIVISION IN TRADESCANTIA PALUDOSA. Dale Steffensen. [1953]. 7p. (BNL-1678)

Abnormal chromosomes are described which were observed in Tradescantia grown for 4 to 7 months in a sulfate-deficient nutrient solution. (C.H.)

1772

Brookhaven National Lab.

AN IMPROVED SEALING WAX FOR TEMPORARY SMEAR PREPARATIONS. Eric Christensen. [1953] 6p. (BNL-1687)

A mixture of polyethylene glycol and gum mastic is suggested as a temporary seal for smear preparations for cytological examination. Directions for preparing the mixture are included. (C.H.)

1773

ABSORPTION AND METABOLISM OF TRITIUM OXIDE AND TRITIUM GAS BY BEAN PLANTS. J. F. Cline, (General Electric Co., Richland, Wash.). *Plant Physiol.* 28, 717-23(1953) Oct.

The uptake of tritium oxide by red kidney bean plants grown in a tritium oxide-labeled nutrient medium was quite rapid for the first few hours, but equilibrium between plant water and nutrient medium was not attained in the 72-hr experimental period. This lack of complete tritium oxide equilibration may be due to slow dilution of colloidal bound water, or possibly to an isotope effect. The rate and extent of tritium incorporation in the plant tissue compounds can be correlated directly with the metabolic activity of the tissue concerned. Absorption of tritium oxide and incorporation of tritium in plant compounds was slightly greater from a nutrient medium of pH 4 than from a nutrient medium of pH 7. Both tritium oxide absorption and

tritium incorporation in plant compounds was markedly reduced in plants grown in the dark. The exposure of a plant leaf to tritium gas resulted in high concentrations of tritium in the plant water of the exposed leaf, much smaller amounts in the plant water from other tissues, and only very slight incorporation in tissue compounds. (auth)

RADIATION EFFECTS

1774

Brookhaven National Lab.

EFFECTS OF IONIZING RADIATION ON IMMUNITY.

William M. Hale, Institute of Pathology, Coll. of Medicine, Univ. of Tenn., Memphis and Richard D. Stoner, Brookhaven National Lab. [1953?] 30p. (BNL-1665)

Ionizing radiation was found to markedly reduce or abolish active or passive immunity to bacterial infections and reduce resistance and active immunity to animal parasite infections. Ionizing radiation was found to have little, if any, effect on acquired immunity to viral infection or active or passive immunity to bacterial toxins. Antibody formation was found to be greatly inhibited by ionizing radiation. There does not appear to be convincing evidence for stimulation of antibody production by small doses of radiation. The inhibitory effect of ionizing radiation on the antibody response was determined to be intimately related to radiation dosage, species, time of antigenic stimulus, soluble or particulate nature of the antigen, and route of antigenic stimulus. (auth)

1775

Brookhaven National Lab.

INCREASED SUSCEPTIBILITY OF MICE TO ANAPHYLACTIC SHOCK FOLLOWING COBALT-60 GAMMA RADIATION.

Richard D. Stoner, Brookhaven National Lab. and William M. Hale, Institute of Pathology, Coll. of Medicine, Univ. of Tenn., Memphis. [1953?] 19p. (BNL-1673)

Gamma radiation exposure of 650 rep markedly enhanced active anaphylactic shock in mice sensitized with alum-precipitated tetanus toxoid and challenged with fluid tetanus toxoid 7 days post-radiation. The enhancing effect of ionizing radiation upon the severity of the anaphylactic response is not of an immediate nature, but appears during a 2- to 7-day post-radiation period. Passive and reversed passive anaphylaxis was more severe in 7-day post-radiated mice sensitized with homologous antibody. Irradiated mice sensitized with anti-bovine albumin rabbit serum demonstrated increased sensitivity to passive anaphylaxis when challenged 1 day later with bovine albumin antigen. Seven-day post-irradiated mice did not show increased sensitivity to intravenous injection of histamine. The antihistaminic agents, Thephorin, Benadryl, and Pyronil, afforded almost complete protection from fatal anaphylaxis in irradiated mice. (auth)

1776

Atomic Bomb Casualty Commission

THE GROWTH AND DEVELOPMENT PROGRAM OF THE ATOMIC BOMB CASUALTY COMMISSION. ANALYSIS OF

BODY MEASUREMENTS TAKEN IN 1951 ON 4,800 HIROSHIMA CHILDREN. Earle L. Reynolds. June 12, 1952. 90p. (NYO-4458)

1777 Atomic Energy Project, Univ. of Calif., Los Angeles
LETHALITY IN RABBITS AS A FUNCTION OF DEPTH DOSE DISTRIBUTION AND AVERAGE DOSE. M. A. Greenfield, M. S. Billings, A. Norman, and A. E. Lewis. Jan. 27, 1954. 19p. Contract AT-04-1-GEN-12. (UCLA-278)

A study of the influence of dose distribution on lethality in small animals exposed to ionizing radiation was made by using two independent x-ray targets which could be energized independently or simultaneously. Depth-dose measurements were made in a water phantom, and determinations were made of the dose-lethality relation in rabbits and rats for various distributions of depth dose as well as for several doses. No difference in lethality resulted from the two different depth-dose distributions used. (C.H.)

1778 THE HEART IN I^{131} -INDUCED MYXEDEMA. COMPARISON OF THE ROENTGENOGRAPHIC AND ELECTROCARDIOGRAPHIC FINDINGS BEFORE AND AFTER THE INDUCTION OF MYXEDEMA. George S. Kurland, Roland E. Schneekloth, and A. Stone Freedberg. *New Eng. J. Med.* 249, 215-22(1953) Aug.

Changes in the size and configuration of the cardiac silhouette in 27 patients and variations in the electrocardiogram in 28 patients with intractable angina pectoris or congestive heart failure were studied before and for two to fifty-three months after the development of I^{131} -induced myxedema. The data indicate that the myxedema heart, in the sense of a condition precipitating angina pectoris or congestive heart failure or accompanied by marked electrocardiographic and x-ray changes, does not occur in patients with prolonged, controlled I^{131} -induced hypothyroidism. (auth)

1779 EFFECT OF IRRADIATION WITH COBALT-60 ON TRICHINA LARVAE. H. J. Gomberg and S. E. Gould (Univ. of Michigan, Ann Arbor). *Science* 118, 75-7(1953) July 17.

Trichinous rat muscle and isolated trichina larvae obtained by the digestion of trichinous rat muscle were placed in lusteroid tubes, which were then placed inside a cylindrical Co^{60} irradiation unit and exposed to doses of radiation ranging from 5120 r to 20,480 r. Larvae which were irradiated in muscle were isolated by artificial digestion of the muscle. The radiation effects were measured by reduction in the ability of the irradiated larvae to mature in six days in the intestinal tract and by the absence of encysting trichina larvae in the muscle tissue of test rats 30 days after ingestion of trichina larvae. Data are tabulated on dosages of Co^{60} γ radiation required for sterilization and for inhibition of maturation of trichina larvae. (C.H.)

1780 CHANGES IN THE CENTRAL NERVOUS SYSTEM FOLLOWING IRRADIATION WITH 23-MEV X-RAYS FROM THE BETATRON. A. Arnold, P. Bailey, R. A. Harvey, L. L. Haas, and J. S. Laughlin (Univ. of Illinois Coll. of Medicine, Chicago). *Radiology* 62, 37-46(1954) Jan.

Studies were undertaken to determine and analyze the effects of x irradiation on the normal brain of the monkey and on tumors of the central system in man. It was concluded that the central nervous system of both monkey and man is more radioresponsive than generally supposed. The effects of x rays on the central nervous system are direct effects, and are not secondary to vascular occlusion. There is a very definite radiosensitivity on the part of the white matter in the adult animal, which is characteristic for the delayed response in the lower dose ranges. Comparable radi-

ation effects are being observed in our patients, receiving x-ray therapy for tumors of the central nervous system. (auth)

1781 STUDIES ON THE MECHANISM OF ACTION OF IONIZING RADIATIONS. XI. INACTIVATION OF YEAST ALCOHOL DEHYDROGENASE BY X-IRRADIATION. E. S. Guzman Barron and Phyllis Johnson (Univ. of Chicago). *Arch. Biochem. and Biophys.* 48, 149-53(1954) Jan. (cf. NSA 6-3738).

Crystalline yeast alcohol dehydrogenase was readily inactivated on x irradiation of dilute aqueous solutions. The degree of inactivation was proportional to the x-ray dose, and the ionic yield was 1.1. The enzyme was completely protected from x-ray inactivation by the addition of glutathione, whereas glutamic acid had no effect at all. Glutathione, added after x irradiation, produced only partial reactivation. Hydrogen peroxide, at concentrations produced on x irradiation of water with x-ray doses 200 times higher than the dose required for complete inactivation, had no effect at all. Inhibition by x rays is attributed to oxidation of SH groups of the protein by the free radicals OH and O_2H formed on x irradiation of water. (auth)

1782 THE BLOOD COUNT IN RADIOGRAPHERS—A GROUP SURVEY. N. R. Fletcher (Auckland Hospital, New Zealand). *Radiography* 20, 19-24(1954) Feb.

Some of the blood changes which may occur through over-exposure to radiation are reviewed, and an analysis is made of the blood records of a group of radiographers. A short analysis of some radiation measurements by test films is also presented. A description is given of the changes which have been noted in the blood counts of the group under observation, and a graphical representation of a typical case is included. (auth)

1783 CHANGES IN THE CELLULAR ELEMENTS OF BLOOD FOLLOWING ADMINISTRATION OF P^{32} . Santosh Mitra, K. L. Bhattacharya, A. Bose, and K. P. Chakraborty (Chittaranjan Cancer Hospital, Calcutta, India). *Acta Radiol.* 40, 593-602(1953) Dec.

Changes in the cellular elements of the blood of white albino rats following the administration of doses of P^{32} , varying from 0.3 $\mu\text{C/g}$ to 4.5 $\mu\text{C/g}$, were studied. Doses up to 2 $\mu\text{C/g}$ were found to be sublethal, and all rats receiving 4.5 $\mu\text{C/g}$ died within 12 days. The radiosensitivity of the blood cells was directly proportional to their life cycle. The amount of lowering of the count of different cellular elements was influenced appreciably by the rate at which the β dosage was applied. (auth)

1784 THE CHEMISTRY OF BIOLOGICAL AFTER-EFFECTS OF ULTRAVIOLET AND IONIZING RADIATIONS. A SYMPOSIUM. I. SOME AFTER-EFFECTS IN FATS IRRADIATED WITH HIGH-ENERGY ELECTRONS AND X RAYS. R. S. Hannan and H. J. Shepherd (Univ. of Cambridge, England). *Brit. J. Radiol.* 27, 36-42(1954) Jan.

Two types of chemical aftereffects have been observed in fats irradiated with high-energy cathode rays and soft x rays. The first is the well-known autoxidation chain reaction which develops much more rapidly than before irradiation. Destruction of natural antioxidants in the fat is probably responsible. The second effect occurs preferentially at -20 to -30°C and is due to a reaction between O and a reactive group which is stable at these temperatures but becomes unstable with increase of temperature and softening of the fat; apparent peroxides and other reactive groups develop and the susceptibility to autoxidation increases.

This effect can occur to some extent at physiological temperature in hard fats. (auth)

1785

THE CHEMISTRY OF BIOLOGICAL AFTER-EFFECTS OF ULTRAVIOLET AND IONIZING RADIATIONS. A SYMPOSIUM. II. THE "AFTER-EFFECT" OF IRRADIATION ON DESOXYRIBONUCLEIC ACID IN OXYGENATED SOLUTIONS. B. E. Conway (Royal Cancer Hospital, London, England). *Brit. J. Radiol.* 27, 42-50(1954) Jan.

Experiments have been carried out to attempt to establish the nature of the aftereffect of x irradiation on desoxyribonucleic acid in O. The change which occurs during 48 hr after the cessation of the radiation is followed by means of viscosity measurements. Very little aftereffect is observed when O is absent, and the explanation of the effect is accordingly sought by considering the effects of the agents (e.g., the radical O_2H and also molecular H_2O_2) produced characteristically in the irradiation of oxygenated aqueous solutions. It is concluded that the effect observed can mainly be accounted for by both the formation of unstable peroxidic intermediates and also the action of hydrogen peroxide formed during the irradiation on nucleic acid damaged by other radicals (e.g., H, OH, and O_2H) formed during the irradiation. Experiments on the effect of various protective agents provide indirect evidence in support of this view. (auth)

1786

THE CHEMISTRY OF BIOLOGICAL AFTER-EFFECTS OF ULTRAVIOLET AND IONIZING RADIATIONS. A SYMPOSIUM. III. INACTIVATION OF BACTERIOPHAGE AFTER IRRADIATION. Tikvah Alper (Hammersmith Hospital, London, England). *Brit. J. Radiol.* 27, 50-4(1954) Jan.

During a series of experiments to determine the effect of O on radioinduced inactivation of bacteriophages it was observed that part-inactivated phage particles retain their ability to adsorb to bacteria and to reproduce themselves, unless acted on by certain specific agents. There is some evidence that, at room temperatures, part-inactivated phage in air-free suspensions does undergo slow inactivation on standing, but the possible presence of H_2O_2 in small amounts has not been excluded. The agents acting on part-inactivated phage appear to be of a reducing nature, and it seems fair to assume the H_2O_2 is itself acting as a reductant on part-inactivated phage. The immediate indirect effects of radiation on phage seem also to be of a reducing nature. Neither OH nor HO_2 radicals have been found to cause part-inactivation or immediate inactivation. Part-inactivation is a surface phenomenon. It does not occur in the irradiation of phage by ultraviolet light, nor in the x irradiation of suspensions highly protected against indirect action. (auth)

1787

THE CHEMISTRY OF BIOLOGICAL AFTER-EFFECTS OF ULTRAVIOLET AND IONIZING RADIATIONS. A SYMPOSIUM. IV. CHEMICAL RESTORATION IN IRRADIATED MICRO-ORGANISMS. R. Laterjet, L. R. Caldas, B. Miletic, and P. Morenne (Institut du Radium, Paris, France). *Brit. J. Radiol.* 27, 54-6(1954) Jan.

Work on the so called "catalase restoration" of *E. coli* following irradiation with heavy doses of ultraviolet light is summarized. Data indicate that the dead bacteria contributed some restoring factor which the authors identified as catalase. Its protective effects are attributed to an enzymatic effect of catalase. Possible mechanisms of protection are discussed. (C.H.)

1788

THE CHEMISTRY OF BIOLOGICAL AFTER-EFFECTS OF ULTRAVIOLET AND IONIZING RADIATIONS. A SYMPOSIUM. V. A DELAYED EFFECT OF X RAYS ON PEPSIN.

Robert S. Anderson (Univ. of South Dakota, Vermillion). *Brit. J. Radiol.* 27, 56-61(1954) Jan.

The inactivation of pepsin by x rays consists of two separable parts, an immediate inactivation and a slowly developing one having a high temperature coefficient of inactivation. The slow reaction is quantitatively larger than the initial one. The slow reaction depends on some modification of the protein during the irradiation. This may include combination with a radical, but in any case permits the usual activity as a catalyst. The slow reaction has been confirmed by others on trypsin and is probably related to a highly temperature-dependent denaturation of egg albumen carefully studied by Fricke. (auth)

1789

THE CHEMISTRY OF BIOLOGICAL AFTER-EFFECTS OF ULTRAVIOLET AND IONIZING RADIATIONS. A SYMPOSIUM. VI. THE EFFECTS OF X RAYS ON-DILUTE SOLUTIONS OF CRYSTALLINE TRYPSIN: CONTINUED INACTIVATION AFTER TERMINATION OF IRRADIATION.

Margaret R. McDonald (Carnegie Institution of Washington, Cold Spring Harbor, New York). *Brit. J. Radiol.* 27, 62-3(1954) Jan.

Preliminary experiments indicate that the rate of continued inactivation of solutions of trypsin previously exposed to x rays is a function of the amount of inactivation caused by the x rays. The larger the initial inactivation, the faster is the rate of the secondary reaction. Dilution of the trypsin solutions after irradiation apparently does not change the rate of the secondary inactivation. (auth)

1790

THE CHEMISTRY OF BIOLOGICAL AFTER-EFFECTS OF ULTRAVIOLET AND IONIZING RADIATIONS. A SYMPOSIUM. VII. ATTEMPTED ESTIMATION OF ORGANIC PEROXIDES IN X-IRRADIATED MICE. V. J. Horgan and J. St. L. Philpot (Atomic Energy Research Establishment, Harwell, England). *Brit. J. Radiol.* 27, 63-72(1954) Jan.

Mice were given a lethal dose of x rays and extracted with n-butanol, and the extracts were tested for organic peroxides. The extracts were found to contain a substance capable at 100°C, but not at 20°C, in 10 min of oxidizing stannous chloride anaerobically and cuprous-catalyzed leuco 2, 6-dichlorophenol indophenol aerobically. The above properties were compared with those of some known peroxides, but do not agree with any of them. (auth)

1791

THE CHEMISTRY OF BIOLOGICAL AFTER-EFFECTS OF ULTRAVIOLET AND IONIZING RADIATIONS. A SYMPOSIUM. VIII. PROTECTION OF MICE AFTER WHOLE-BODY X IRRADIATION. P. Bonet-Maury and F. Patti (Institut du Radium, Paris, France). *Brit. J. Radiol.* 27, 72-6(1954) Jan.

A procedure is described which is used in testing the protective effects of various chemical and biological substances against radiation mortality of mice. Pre-irradiation exposure to coal gas, KCN, and malonitrile gave definite protection as indicated by the percentage mortality and by the observation of animals surviving longer than one month. None of the post-treatments tested led to survival of mice exposed to lethal doses of 800 r x radiation. Chemical substances tested which gave no lasting protective effects include intraperitoneal injections of catalase, dinitra, sulfocyanide, NaF alone and with PO_4^{3-} plus Ca^{+2} , $HgCl_2$, hydroquinone, P.A.S., thiourea, gallic acid, thiomalic acid, and formol. Antithyroid agents, narcotics, temperature, antidiarrhetic agents, antihemorrhagic agents, Bardach's serum, liver extract, spleen extract, and antihistamine agents gave no beneficial results. Data are tabulated on dose, method of administration, number of animals, mean survival time, and percent of survivors. (C.H.)

1792

THE CHEMISTRY OF BIOLOGICAL AFTER-EFFECTS OF ULTRAVIOLET AND IONIZING RADIATIONS. A. SYMPOSIUM. IX. INDUCTION OF FILAMENTOUS FORMS IN ULTRAVIOLET-IRRADIATED *E. COLI* B. Maurice Errera (Univ. of Brussels, Belgium). *Brit. J. Radiol.* **27**, 76-80 (1954) Jan.

Ultraviolet induction of filamentous forms in growing *E. coli* has been described. The speed of growth is decreased after irradiation, and cytoplasmic cleavage is very markedly inhibited. On the other hand, nuclear division appears to continue almost normally as well as synthesis of new cytoplasm. An attempt has been made to use this phenomenon as a test for the study of reactivation by physical and chemical agents. Visible light is a very good reactivating agent; ATP and hydrosulfite appear to have a slight reactivating capacity the intensity of which awaits observations of a more quantitative nature. (auth)

1793

ADENOSINE TRIPHOSPHATASE AND 5-NUCLEOTIDASE ACTIVITY OF HEMATOPOIETIC TISSUES OF IRRADIATED ANIMALS. Kenneth P. Dubois and Donald F. Petersen (Univ. of Chicago). *Am. J. Physiol.* **176**, 282-6(1954) Feb.

Periodic adenosine triphosphatase and 5-nucleotidase measurements on spleen and thymus glands from rats and mice exposed to sublethal doses of x irradiation showed that these tissues exhibit an increased ability to hydrolyze adenosine triphosphate and 5-adenylic acid which becomes evident as early as 3 hr post-irradiation and reaches a maximum within 72 hr. The alteration in enzyme activity was reversible with the rate of reversal depending upon the dose of x ray. Within the dose range of 25 to 400 r the amount of increase in the adenosine triphosphatase activity of the spleens and thymus glands of rats was directly related to the dose of x ray administered. Doses in excess of 400 r did not evoke additional increases in the adenosine triphosphatase activity of hematopoietic tissues. A similar relationship between dosage of x ray and nucleotidase activity was observed in the spleens and thymus glands of rats when doses between 100 and 400 r were administered. Lethal doses of x ray caused an irreversible increase in the adenosine triphosphatase and 5-nucleotidase activity of the spleens and thymus glands of rats and mice. (auth)

RADIATION HAZARDS AND PROTECTION

1794

Brookhaven National Lab.
PROTECTIVE PROPERTIES OF CYSTEINE, SODIUM HYPOSULFITE AND SODIUM CYANIDE AGAINST RADIATION INDUCED CHROMOSOME ABERRATIONS. Knut Mikaelson. [1953] 17p. (BNL-1674)

The protective effect of cysteine, sodium hyposulfite ($\text{Na}_2\text{S}_2\text{O}_4$), and NaCN against chromosome fragmentation in *Tradescantia* induced by γ irradiation is demonstrated. (auth)

1795

EDUCATION AND TRAINING OF HEALTH PHYSICISTS.

Elda E. Anderson (Oak Ridge National Lab., Tenn.). *Radiology* **62**, 83-7(1954) Jan.

The increased demand for trained health physicists due to the increased use of radioisotopes in industry and research and the new problems in civil and military defense are discussed. The duties of health physicists and educational requirements necessary to perform these duties are summarized. The role of the AEC program of training for fellows in radiological physics in supplying the need for trained health physicists is reviewed. (C.H.)

1796

GLUTATHIONE AND X-RAY INJURY IN HYDRA AND

PARAMECIUM. George E. Daniel and Helen D. Park (Public Health Service, Bethesda, Md.). *J. Cellular Comp. Physiol.* **42**, 359-67(1953) Dec.

Glutathione added to irradiated saline media prevented the damaging actions on the tentacles of hydra and reduced the lethal effects on paramecia, observed when the animals were placed in untreated irradiated saline. (C.H.)

RADIATION SICKNESS

1797

RADIATION SICKNESS IN THE MONKEY. Earl Eldred and William V. Trowbridge (Univ. of California, Los Angeles). *Radiology* **62**, 65-73(1954) Jan.

Features of radiation sickness in a subhuman primate have been obtained from clinical and physiological observations in a series of total-body x irradiation at several dosage levels. Dosage-mortality data for the monkey indicate that the $\text{LD}_{50/30}$ is about 600 r, while the $\text{LD}_{100/30}$ lies near 800 r. In the monkey, conspicuous phases of radiation sickness include vomiting during irradiation, a symptomless stage after irradiation, a period of gastrointestinal disturbances, and a period of hemorrhage and infection, followed by convalescence. Early deaths occurred in two waves associated with the gastrointestinal and with the hemorrhagic phases. Later deaths were scattered. In the monkey, epilation and cutaneous hemorrhages are not present with sufficient regularity to serve as exclusive criteria for exposure to radiation within the lethal range. Alterations in the blood picture, determined in these animals and reported elsewhere, appeared to be the most sensitive index. (auth)

RADIOTHERAPY

1798

THE QUANTITATIVE ELECTRODEPOSITION OF RADIO-RUTHENIUM. J. C. Griess, Jr. (Oak Ridge National Lab., Tennessee). *J. Electrochem. Soc.* **100**, 429-33(1953) Oct.

A study has been made to determine the conditions necessary for the complete (~99%) electrodeposition of radio-ruthenium. Bright adherent deposits suitable for small radioactive sources were obtained from acid solutions containing moderately low concentrations (5×10^{-3} to $5 \times 10^{-6}\text{M}$) of ruthenium nitroso salts. The minimum cathode potential at which complete deposition was possible was about -0.45 volt vs. a saturated calomel electrode. (auth)

1799

RADIOIODINE TREATMENT OF THYROTOXICOSIS: A SINGLE DOSE METHOD FOLLOWING A DRUG PREPARATION. Russell Fraser, John D. Abbott, and F. S. Stewart (Hammersmith Hospital, London, England). *Brit. J. Radiol.* **27**, 23-30(1954) Jan.

Thirty-two thyrotoxic patients were treated with radioiodine by a single dose procedure after drug preparation with thiouracil and thyroxine; at a one-year follow-up, 26 had remitted, 5 had needed re-treatment and 1 had permanent myxoedema. This clinical response could be related to the estimated mean radiation received by the thyroid calculated in radiation dose units. This depended partly on the planned dose given (100, 150, or 250 μg thyroid at 48 hr) and partly on the effective half life of the iodine in the thyroid. The thyroid glands of those patients given a routine drug preparation with thiouracil and thyroxine retained the iodine longer (biological half life 27.8 days) than those given an atypical drug preparation (biological half life 10.6 days). The clinical management of the radioiodine treatment of thyrotoxicosis has been simplified by a drug preparation. It can be so planned that a single dose will frequently suffice. (auth)

1800

EXPERIENCE WITH THE 30 MEV SYNCHROTRON AS A

RADIOTHERAPEUTIC INSTRUMENT. III. APPROACH TO CLINICAL USE. J. S. Mitchell, C. L. Smith, D. J. Allen-Williams, and R. Braams (Univ. of Cambridge, England). *Acta Radiol.* **40**, 603-13(1953) Dec.

The paper is an account of the beginning of the clinical use of the 30-Mev synchrotron in radiotherapy. The problem of relative biological efficiency is considered from the practical point of view of dose levels likely to be required. An account is given of 3 illustrative cases treated by means of 30-Mev roentgen therapy and comparison is made with conventional radiotherapy. The advantages and disadvantages of 30-Mev roentgen therapy are discussed. (auth)

TOXICOLOGY STUDIES

1801

THE STATE OF BERYLLIUM IN BLOOD PLASMA. Isaac Feldman, Jean R. Havill, and W. F. Neuman (Univ. of Rochester, N. Y.). *Arch. Biochem. and Biophys.* **46**, 443-53(1953) Oct.

Dialysis studies of Be added to plasma, sera, and aqueous solutions show the transport of this ion to be determined principally by inorganic phosphate and citrate anions. Significant interaction between Be and protein could be demonstrated only with carrier-free Be⁷, but polyphosphate compounds, including pentose nucleic acid, formed slightly dissociated complexes. (auth)

1802

RELATIVE BIOLOGICAL EFFECTIVENESS OF RADIUM AND OTHER ALPHA EMITTERS IN CF NO. 1 FEMALE MICE. Miriam P. Finkel (Argonne National Lab., Lemont, Ill.). *Proc. Soc. Exptl. Biol. Med.* **83**, 494-8(1953) July.

Pu²³⁹, Po²¹⁰, U²³³, and Th²²⁸ were 20 times as effective as Ra²²⁶ in killing 50% of a population of mice in 20 to 100 days after intravenous administration. At levels approaching those that produced no effect, Po was 3 times as effective, Pu was equally effective, and U²³³ was slightly less effective than Ra in decreasing the expectation of life. The ratios relative to Ra of the proportion of mice that developed malignant bone tumors after the latent period were 7:1 for Pu and 2:1 for U²³². U²³³ and Po were less effective than Ra in this instance. (auth)

TRACER APPLICATIONS

1803

Brookhaven National Lab.

XENON CONCENTRATION CHANGES IN BRAIN AND OTHER BODY TISSUES OF THE DOG DURING INHALATION OF THE GAS. C. B. Pittinger, R. M. Featherstone, E. G. Gross, E. E. Stickley, and L. Levy, Brookhaven National Lab. and Iowa State Univ., Coll. of Medicine. [1953] 15p. (BNL-1666)

A study has been made of Xe concentration changes in brain and other body tissues of the dog during inhalation of radioactive Xe. The Xe concentrations of the thalamus, hypothalamus, caudate nucleus and medulla oblongata were similar and significantly higher than those of the cerebral parietal cortex at the 2- and 6-min periods of inhalation. Whereas four of the five brain tissues studied were saturated within about 6 min, the cerebral parietal cortex may not be completely saturated even after a 20-min period of inhalation of Xe at a constant tension. The Xe concentration of adrenal gland tissue rises rapidly and exceeds that of the brain tissues after about a 10-min period of inhalation. Kidney, liver, and striated muscle absorb Xe more slowly than the other tissues studied. (auth)

1804

Brookhaven National Lab.

THE EFFECTS OF CHORIO-ALLANTOIC TRANSPLANTS

OF ADULT CHICKEN TISSUES ON HOMOLOGOUS TISSUES OF THE HOST EMBRYO. James D. Ebert, Brookhaven National Lab. and Indiana Univ. [1953]. [BNL-1672]

Adult chicken spleen and kidney and adult mouse spleen, labeled with S³⁵ by injection of S³⁵ methionine into the adult fowl 12 hr before sacrifice, were transplanted to the chorio-allantoic membrane of 9-day chicken embryos. After 3 or 5 days the transplants and host spleen, liver, and kidney were recovered, and the specific activity of the radiosulfur in protein and non-protein fractions of donor and host tissues was determined. The results indicate a selective incorporation from grafts into homologous host tissues of tissue-specific protein constituents larger than amino acids. (auth)

1805

LOCALIZATION OF INTRACRANIAL NEOPLASMS WITH RADIOACTIVE ISOTOPES. William B. Seaman, Michel M. Ter-Pogossian, and Henry G. Schwartz (Washington Univ. School of Medicine, St. Louis, Mo.). *Radiology* **62**, 30-6 (1954) Jan.

Clinical experience with the diiodofluorescein technique of brain tumor localization in 200 patients is presented. A correct localization was obtained in 46.0% of 65 verified brain tumors. Failure to localize a tumor may be the result of an unfavorable location or of biologic characteristics that interfere with the basic mechanism of localization of the medium. The clinical status of this test is yet to be definitely determined, but it appears to be a useful screening procedure to aid in the selection of patients for further diagnostic studies. (auth)

CHEMISTRY

1806

Knolls Atomic Power Lab.

THERMOLYSIS OF ZINC-MONOSALICYLALDOXIME. Joseph Rynasiewicz and John F. Flagg. [1953] 4p. Contract W-31-109-Eng-52. (AECU-2793)

The correct drying temperature for Zn monosalicylaldehyde lies between 25 and 285°C, depending on the moisture content of the sample and the heating (drying) rate. The wet sample starts to lose moisture at ~60°C and decomposes very rapidly at 290°C. A Zn complex of variable composition (probably a mixture of Zn(OH)₂ and Zn salicylaldehyde) resulted when less than the stoichiometric amount of salicylaldehyde reagent was used for the precipitation of Zn. When a 20% excess of reagent was used, Zn monosalicylaldehyde Zn(C₇H₅O₂N) was formed. In all cases, a constant weight for the final ignition residue was obtained between 500 and 1000°C. This observation is in variance with other thermolysis data which showed that the Zn salicylaldehyde complex is converted to ZnO at 950°C. (auth)

1807

Atomic Energy Research Establishment, Harwell, Berks (England)

THE THERMAL DECOMPOSITION OF THORIUM OXALATE. R. W. M. D'Eeye and P. G. Sellman. Nov. 2, 1953. 11p. (AERE-C/R-1286)

The thermal decomposition of Th oxalate dihydrate was studied in the temperature region 270 to 900°C in both air and N atmosphere. The water of hydration is readily removed at 270°. At 330° decomposition takes place with liberation of CO and CO₂, the quantity of CO being slightly greater than that of CO₂. The results are compatible with formation of a carbonate as an intermediary in the degrada-

tion process. Some free C is found which is probably formed by disproportionation of CO. The ThO_2 prepared at low temperatures (300 to 500°) from the oxalate has a small crystallite size and is hygroscopic. (auth)

1808

Armour Research Foundation

ALKALI AND ALKALINE EARTH HALIDE, FLUOBORATE AND BORATE SYSTEMS. Jan. 28, 1954. 16p. (CCC-1024-TR-3)

Mathematical analysis of the interionic attractive and repulsive forces involved in binary mixtures of the alkali metal halides leads to equations which may be used to predict the eutectic temperatures. Qualitatively, it may be seen that the lowest eutectic temperature will result when the common anion is the largest possible and the difference between the radii of the cations is as large as feasible. The experimental results verify the theoretical analysis; however, the best system (LiI-RbI) is just at the upper temperature limit, 250°C, for the practical production of diborane. (auth)

*1809

Ames Lab.

THE KINETICS OF THE REDUCTION OF PERCHLORATE ION BY Ti(III) IN DILUTE SOLUTION. Frederick R. Duke and Paul R. Quinney. Jan. 13, 1954. 15p. Contract W-7405-eng-82. (ISC-438)

The reduction of perchlorate ion by Ti(III) in dilute solutions appears to proceed by several paths. The reaction has $[\text{H}^+]$ -dependent as well as $[\text{H}^+]$ -independent paths. The addition of chloride retards the reaction, apparently due to the formation of TiCl^{+2} ion. The reaction is linear in ClO_4^- at concentrations below about 1.0M. Above this concentration the reaction rate increases, this probably being due to the increased activity coefficient of the perchlorate ion at higher concentrations. There was insufficient complex ion formation between Ti(III) and ClO_4^- to be kinetically detectable. The activation energies for the various reactions were calculated, and a mechanism proposed. (auth)

1810

Ames Lab.

THE KINETICS OF THE PERIODATE OXIDATION OF ETHYLENE GLYCOL AND A SERIES OF METHYLATED ETHYLENE GLYCOLS. Frederick R. Duke and Vernon C. Bulgrin. Jan. 13, 1954. 16p. Contract W-7405-eng-82. (ISC-441)

The specific periodate oxidation of the homologous series of glycols, ethylene glycol through pinacol, shows a discontinuity in mechanism between trimethylethylene glycol and pinacol. The latter is very slowly oxidized in an acid-catalyzed bimolecular step, whereas the former, as with the other glycols studied, proceeds rapidly in a non-catalyzed unimolecular step. The effect of stepwise methyl group substitution in ethylene glycol is determined, both on the free energy of complex formation with periodate and on the unimolecular rate constant. (auth)

1811

Mound Lab.

DETERMINATION OF THE FORMULA OF AN OXIDE OF POLONIUM. A. W. Martin. July 7, 1953. Decl. Nov. 2, 1953. 21p. Contract AT-33-1-GEN-53. (MLM-855)

A discussion of the procedures and apparatus used in establishing the stoichiometric relationship of Po to O as PoO_2 is given. The results of four separate determinations are set forth. Steps for the purification of Po by fractional volatilization are described. The amount of dry O_2 reacting was ascertained by measuring the pressure decrease of a known volume of gas in contact with a known amount of Po at a chosen temperature (room and 25°C). These data were obtained with a Bourdon gage of Pyrex glass used to observe

the pressure difference accompanying the reaction. X-ray-diffraction data on both PoO_2 prepared in these experiments and PoO_2 formed in the decomposition of the nitrate of Po gave additional evidence of the existence of quadrivalent Po, Po^{+4} . From the data observed and presented, it is concluded that the yellow dioxide, PoO_2 , is formed when dry O_2 is allowed to react with Po. The reaction is slow at room temperature; however, the reaction rate increases with temperature and is quite rapid at 300°C. (auth)

1812

Pennsylvania State Univ.

STUDIES ON COORDINATION COMPOUNDS. 12. CALCULATION OF THERMODYNAMIC FORMATION CONSTANTS AT VARYING IONIC STRENGTHS. Reed M. Izatt, Charles G. Hass, Jr., B. Peter Block, and W. Conrad Fernelius. Dec. 16, 1953. 16p. Contract AT(30-1)-907. (NYO-3636)

Stepwise thermodynamic formation constants have been determined potentiometrically in aqueous solution for the reaction of Zn^{2+} , Ni^{2+} , Ce^{3+} , and Pr^{3+} with the acetylacetonate ion. Concentration constants were calculated at varying M^+ concentrations (having the same M^+ -acetylacetonate ratio) and at varying ionic strengths (obtained by the addition of standard NaClO_4 solution). These concentration constants were converted by means of activity coefficients, calculated from the Debye-Hückel equation, to thermodynamic constants. The agreement of the several thermodynamic constants for each metal ion was good at the lower metal ion concentrations and at ionic strengths up to about 0.10. The temperature was maintained at $30.0 \pm 0.1^\circ\text{C}$. All salts used were perchlorates. Two examples of other metal ion-ligand systems which are taken from the literature are discussed, in which several constants at varying ionic strengths are reported. These are the Pb^{2+} -citrate and the Cu^{2+} -, Ni^{2+} -, Cd^{2+} -, and Mg^{2+} -malonate systems. The Debye-Hückel theory is shown in each case to be applicable in converting these concentration constants to a thermodynamic constant. (auth)

1813

HYDROGEN SUPEROXIDE, HO_2 , AS AN INTERMEDIATE COMPOUND. K. V. Astakhov and A. G. Getsov. Translated by May Avery from Doklady Akad. Nauk S.S.S.R. 81, 43-5(1951). 5p. (AEC-tr-1771)

While studying the properties of CaO_4 , a gradual evaluation of O_2 during the reaction of a dilute acid with CaO_4 was observed. The mechanism $\text{CaO}_4 + \text{acid} \rightarrow \text{Ca(OH)}_2 + 2\text{HO}_2$ and $2\text{HO}_2 \rightarrow \text{H}_2\text{O}_2 + \text{O}_2$ is proposed instead of the direct reaction $\text{CaO}_4 + \text{acid} \rightarrow \text{Ca(OH)}_2 + \text{H}_2\text{O}_2 + \text{O}_2$. (J.S.R.)

1814

AN INTERNATIONAL BIBLIOGRAPHY ON ATOMIC ENERGY. VOL. 2. SCIENTIFIC ASPECTS. SUPPL. 2. United Nations, N. Y., Atomic Energy Section, Department of Security Council Affairs, 1953. 320p. (AEC/INF/10/Rev.1/Add. 2)

This volume lists 7997 articles published in all parts of the world during 1951-52 dealing with the scientific aspects of research in the field of atomic energy. It is divided into five main sections covering fundamental nuclear science, physics and engineering of nuclear energy, biological and medical effects of high energy radiation, isotopes in biology and medicine, and applications of nuclear physics in non-biological sciences and technology. (C.H.)

1815

THE HEAT CAPACITY OF CHROMIUM CARBIDE (Cr_2C_3). R. A. Oriani and W. K. Murphy (General Electric Research Lab., Schenectady, N. Y.). J. Am. Chem. Soc. 76, 343-5 (1954) Jan. 20.

A Bunsen drop calorimeter has been constructed for the measurement of the heat capacities at high temperatures of substances of interest in the field of physical metallurgy. The operation and reliability of the instrument was checked by the use of pure alumina. The enthalpy of Cr_2C_3 was measured relative to 0° up to 915° with satisfactory agreement

with former data. Entropy, enthalpy, and free energy functions relative to 0°K are tabulated at even temperature intervals. (auth)

1815

MAGNETIC PROPERTIES OF TITANIUM SESQUIOXIDE.

Stephen F. Adler and P. W. Selwood (Northwestern Univ., Evanston, Ill.). *J. Am. Chem. Soc.* **76**, 346-7(1954) Jan. 30.

Magnetic susceptibility measurements over a range of temperature have been made on pure Ti_2O_3 , on the sesquioxide supported on γ -alumina, and on solid solutions of Ti_2O_3 and Al_2O_3 . The pure sesquioxide is antiferromagnetic with a Curie point near 248°K. In supported and dissolved forms the tripositive Ti ion shows increasing susceptibility with increasing magnetic dilution. At infinite dilution the magnetic moment is approximately that expected for one unpaired electron spin. Some phases show a slight ferromagnetism. (auth)

1817

MAGNETOCHEMISTRY OF TECHNETIUM AND RHENIUM.

C. M. Nelson, G. E. Boyd, and Wm. T. Smith, Jr. (Oak Ridge National Lab., Tenn.). *J. Am. Chem. Soc.* **76**, 348-52 (1954) Jan. 20.

A magnetic susceptibility apparatus was constructed and the Faraday method was employed to make measurements on small quantities (20-200 mg) of Tc and Re substances from 78 to 410°K. The heptavalent compounds showed a small, temperature-independent paramagnetism, while the susceptibilities exhibited by the quadrivalent complex compounds followed the Curie-Weiss equation and gave effective magnetic moments which indicate three unpaired electrons. The susceptibilities of the dioxides, however, were small compared with MnO_2 , and the Curie-Weiss relation was not obeyed. The magnetic behavior of metallic Tc and Re was found to be similar to that for Mn. A qualitative discussion of the susceptibilities shown by these three elements was made in terms of Pauling's theory of metals. (auth)

1818

CHEMISTRY OF ARSENIC-BORON BONDING: ARSINE BORINES AND ARSENOBORINE POLYMERS.

F. G. A. Stone and Anton B. Burg (Univ. of Southern Calif., Los Angeles). *J. Am. Chem. Soc.* **76**, 386-9(1954) Jan. 20.

The methylarsines form borine complexes which are more easily dissociated than the corresponding phosphine borines, but show a similar increase of stability, and difficulty of losing H, with methylation. The existence of arsine borine could not be recognized. The protolytic reactions occur far more readily than those of the phosphine borines, with formation of fairly similar polymers, such as those of the $(CH_3)_2AsBH_2$ unit. The trimer of $(CH_3)_2AsBH_2$ (m.p. 50°, b.p. est. 250°, yield 80%) is stable up to 200°, and requires such a temperature for hydrolysis—some 100° lower than for trimeric $(CH_3)_2PBH_2$. The tetramer of $(CH_3)_2AsBH_2$ (m.p. 150°, b.p. est. 352°, yield 6%) is less stable than the trimer, to which it is partially converted at 180°. A higher polymer of $(CH_3)_2AsBH_2$, formed in far larger yield (14%) than the corresponding P compound (ca. 1%) is converted to trimer, with less tetramer, on heating. The trimer and tetramer can be recrystallized from organic solvents in the open air. Their lesser stability and greater reactivity, relative to the $(CH_3)_2PBH_2$ polymers, can be ascribed to the relative weakness of bonding electrons in the 4 quantum level of arsenic. (auth)

1819

HIGH TEMPERATURE HEAT CONTENTS OF MANGANESE SESQUIOXIDE AND VANADIUM MONOXIDE.

Raymond L. Orr (Bureau of Mines, Berkeley, Calif.). *J. Am. Chem. Soc.* **76**, 857-8(1954) Feb. 5.

High temperature heat content measurements of crystal-

line Mn_2O_3 and VO were conducted throughout the temperature intervals 298 to 1350°K and 298 to 1698°K, respectively. A table of smooth values of heat content and entropy increments above 298.16°K is included, and the heat contents also are represented algebraically. (auth)

1820

LOW CONCENTRATION CHEMISTRY. VII. INVESTIGATIONS ON THE ROLE OF ADSORPTION IN RADIOCOLLOID FORMATION. George K. Schweitzer and W. Morrison Jackson (Univ. of Tennessee, Knoxville). *J. Am. Chem. Soc.* **76**, 941-4(1954) Feb. 5.

The assumption that the primary factor in radiocolloid formation is an adsorption phenomenon was tested with Ca^{45} , Na^{22} , Ce^{134} , S^{35} , I^{131} , and P^{32} . Under the experimental conditions Na, Cs, SO_4^{2-} , and I^- showed no definite evidence of radiocolloid formation. Ca and PO_4^{3-} showed some type of aggregation which allowed some removal. However, in neither case did the removal exceed 50% nor were the curves similar to those of elements previously reported to be radiocolloidal. The adsorption curves of I^- , SO_4^{2-} , and PO_4^{3-} on clay or C were not at all similar to removal curves obtained by filtration or centrifugation. It is concluded that adsorption of ions upon impurities does not appear to be the primary factor in radiocolloid formation. (J.S.R.)

1821

STUDIES ON THE BEHAVIOUR OF HALIDES OF TRANSITION METALS WITH AMMONIA. PART III. THE REACTION OF ZIRCONIUM AND THORIUM TETRACHLORIDES WITH AMMONIA. G. W. A. Fowles and F. H. Pollard (Univ. of Southampton and Univ. of Bristol, England). *J. Chem. Soc.* **4128-32**(1953) Dec.

The reaction of Zr and Th tetrachlorides with ammonia has been studied tensimetrically at -36° and -44°. Whereas $ZrCl_4$ gives an amidochloride, $ZrNH_2Cl_3$, $ThCl_4$ forms only an addition complex which dissociates into its constituents in vacuo at 200°. The mechanism of the reaction of ammonia with the Group IVA tetrachlorides is discussed and compared with the mechanisms proposed in recent analogous "alcoholysis" studies. (auth)

1822

PHYSICAL PROPERTIES OF SOME PHASE INCLUSIONS.

G. V. Samsonov (Moscow Institute of Non-Ferrous Metals and Gold, Russia). *Doklady Akad. Nauk S.S.S.R.* **93**, 689-92 (1953) Dec. 1. (In Russian)

The physico-chemical properties of Ti, V, Zr, Nb, Mo, Ta, and W and their borides, carbides, and nitrides are discussed on the basis of their d-level electron structure. Some of the properties are tabulated. (J.S.R.)

1823

OBTAINING ZIRCONIUM CARBIDE IN A VACUUM.

G. A. Meerson and G. B. Samsonov (Moscow Inst. of Nonferrous Metals and Gold, Russia). *Zhur. Priklad. Khim.* **25**, 744-48(1952) July. (In Russian)

By observing the rate of increase of CO given off in calcining a mixture of ZrO_2 and carbon black, it was found that the reaction $ZrO_2 + 3C = ZrC + 2CO$ is additive and is composed of successive reactions in which Zr_2O_3 and ZrO are formed. The practical temperature range at which the reaction with formation of ZrC will proceed in a vacuum was established and the intermediate reactions were discovered. It is possible to obtain by the vacuum process ZrC which contains no N or O admixtures. A fundamental error was found in the work of Prescott and Hincke (*J. Chem. Soc.* **49**) who suggest equal coexistence of ZrO_2 and ZrC in the same reaction. (J.S.R.)

ANALYTICAL PROCEDURES

1824

MANDELIC ACID AND HALOGEN-SUBSTITUTED MAN-

DELIC ACIDS AS REAGENTS FOR THE DETERMINATION OF ZIRCONIUM. R. Belcher, A. Sykes, and J. C. Tatlow (The Univ., Edgbaston, Birmingham, England). *Anal. Chem. Acta* **10**, 34-47(1954) Jan. (In English)

Fluoro (o, m, and p)- and -trifluoromethylmandelic acids have been prepared and an assessment has been made of their value as precipitants for Zr. Though the p-derivatives are satisfactory there are no obvious advantages in their use. Direct weighings of Zr mandelate and p-bromomandelate, about which there have been conflicting reports in the literature, have been investigated also. p-Bromomandelic acid has been used successfully for the determination of amounts of ZrO_2 between 3 and 50 mg/100 ml, but ignition of the precipitate to ZrO_2 is necessary. Of the acids examined, mandelic itself gives the only precipitate which is almost constant and stoichiometric in composition. The composition of this compound, however, varies slightly with the amount of Zr present in the solution under test, and though an overall empirical factor can be applied its use is recommended only if a high order of accuracy is not required. If a series of determinations in a narrow range is to be carried out by direct weighing of Zr mandelate, more accurate results might be obtained by determination of the appropriate factor for that range. (auth)

1825

THE DETERMINATION BY RADIOACTIVATION OF THE OXYGEN CONTENT OF POWDERED METALS WITH PARTICULAR REFERENCE TO BERYLLIUM. R. G. Osmond and A. A. Smales (Atomic Energy Research Establishment, Harwell, England). *Anal. Chim. Acta* **10**, 117-28(1954) Feb. (In English)

A radioactivation method for the determination of O in Be metal powder is described. The sample, mixed with LiF, is irradiated in the Harwell Pile. F^{18} is chemically separated and its activity compared with that from standards similarly treated. The method has given reproducible results in reasonable agreement with those obtained by several other methods which were being investigated simultaneously. (auth)

1826

THE DETERMINATION OF LITHIUM IN MAGNESIUM-LITHIUM ALLOYS BY INTERNAL-STANDARD FLAME PHOTOMETRY. A. M. Robinson and T. C. J. Ovenston (Admiralty Materials Lab., Holton Heath, Poole, Dorset, England). *Analyst* **79**, 47-50(1954) Jan.

The use of a double-beam flame photometer of simple design for the determination of 11 to 14% of Li in Mg-Li alloys is described. The internal-standard technique is used, and its general application to the determination of alkali metals as major constituents is discussed. In the example given, the internal standard selected is K, which, when added in amounts to give a comparatively large concentration, minimizes errors caused by variations in alloy composition. Accuracy is to within $\pm 1\%$ for 11 to 14% of Li. Sodium and small amounts of K in the alloys do not interfere, and Ag, Zn, Al, and Cd, if totalling not more than 10% of the alloy, also have no effect. (auth)

1827

DETERMINATION OF THE PROPORTION OF MESOTHORIUM, RADIUM, AND RADIOTHORIUM IN AN AMPOULE OF COMMERCIAL MESOTHORIUM. Irène Curie (Curie Lab., Paris, France). *J. phys. radium* **15**, 1-6(1954) Jan. (In French)

By means of a scintillation counter with an energy selector, the proportion of Ra^{228} , Ra, and Th^{228} contained in a sealed ampoule can be determined. It can be easily determined, therefore, that a tube of Ra is free of Ra^{228} and Th^{228} . (tr-auth)

CRYSTALLOGRAPHY AND CRYSTAL STRUCTURE 1828

Illinois Inst. of Tech.

INVESTIGATION OF IMPERFECTIONS IN SOLIDS. PROGRESS REPORT COVERING THE PERIOD MARCH TO DECEMBER 1953. Theodore J. Neubert. Jan. 15, 1954. 8p. Contract AT(11-1)90. (COO-146)

The study of the order-disorder transition in $AgHgI_4$, using measurements of internal friction and elastic modulus, is continued. Recent results are discouraging by reason of lack of reproducibility. The order-disorder transition in Ag_2HgI_4 is also being studied using electrical conductivity measurements. The requisite bridge has been constructed and tested, and a preliminary run made on pressed-powder disks. The x-ray-induced coloration of single crystals of NaCN is being investigated. At room temperature the crystals color readily but bleach very rapidly on subsequent standing. The coloration, however, becomes stable in crystals cooled to $0^\circ C$, suggesting that since the CN^- ions are "frozen in place" at $0^\circ C$, the instability of the color could be related to the thermal reorientation of CN^- ions at temperatures above $15^\circ C$. In cooling NaCN crystals to $0^\circ C$ a cloudiness occurs. This turbidity is to a certain extent reversible, and measurements are underway to determine the size, number, and dielectric constant fluctuation descriptive of the scattering centers causing the cloudiness. (auth)

1829

Cornell Univ.

STRUCTURES OF FLUOROCARBONS, ELEMENTARY BORON, AND BORON COMPOUNDS. J. L. Hoard. Jan. 15, 1954. 6p. Contract AT(30-1)-878. (NYO-3947)

A study of the structure of tetragonal and monoclinic B and the determination of the unit cell and probable space group of crystalline perfluorosuccinic acid are briefly presented. (J.E.D.)

1830

TRANSITION METAL DIBORIDES. Benjamin Post (Polytechnic Inst. of Brooklyn, N. Y.), Frank W. Glaser and David Moskowitz (American Electro Metal Corp., Yonkers, N. Y.). *Acta Met.* **2**, 20-5(1954) Jan. (In English)

Structural characteristics of eight transition metal diborides (Ti, Zn, Hf, V, Nb, Ta, Cr, and Mo) have been investigated. It was found that in these hexagonal compounds the length of the *a* axis is determined primarily by B-B contacts in the case of the diborides of the smaller metal atoms, whereas in the diborides of the larger metal atoms, the metal atoms are the determining factor. Enlarged metal atoms were postulated to explain variations in lattice dimensions and *c* to *a* ratios. An examination of the melting points of the diborides relative to those of their respective metals indicated that they reflect primarily the strength of the Me-B bonds in these structures. The extent of mutual solid solubility appeared to depend mainly upon size factor considerations. In cases of solid solution between two diborides where one of these was of a more highly ordered structure than the other, the more disordered phase was favored. (auth)

DEUTERIUM AND DEUTERIUM COMPOUNDS

1831

PRECISION DETERMINATION OF DEUTERIUM IN AQUEOUS SOLUTIONS BY A PYCNOMETER METHOD. Louis Silverman and Wanda Bradshaw (North American Aviation, Inc., Downey, Calif.). *Anal. Chim. Acta* **10**, 68-77(1954) Jan. (In English)

Precision determination of D_2 (D_2O) in aqueous mixtures was made by a pycnometer method over the range from 1 to 99 at. % D_2 . The average deviation was ± 0.02 at. % D_2 . Ab-

solute values of high-D₂ content samples are obtained by reference to a sample of high D₂O content (>99 at. % D₂) which has been measured by a mass spectrometer, instead of to distilled water. Matched standards are also provided for intermediate-content (25 to 75 at. %) D₂O samples. (auth)

1832

RATE OF DEUTERIUM EXCHANGE OF CERTAIN AMINES AND ALCOHOLS. Jack Hine and Cyrus H. Thomas (Georgia Inst. of Tech., Atlanta). *J. Am. Chem. Soc.* **76**, 612(1954) Jan. 20.

An attempt was made to study the rate of exchange of D between amines and alcohols. The exchanges between ethylamine and *n*-heptylamine, *t*-butyl alcohol and di-*t*-butylisopropylcarbinol, and ethylamine and *t*-amyl alcohol were too rapid to be followed. The investigation has been discontinued. (J.S.R.)

1833

THE KINETICS OF THE BASE-CATALYZED DEUTERIUM EXCHANGE OF CHLOROFORM IN AQUEOUS SOLUTION. Jack Hine, Roy C. Peek, Jr., and Billy D. Oakes (Georgia Inst. of Tech., Atlanta). *J. Am. Chem. Soc.* **76**, 827-9(1954) Feb. 5.

The kinetics of the reaction of CDCl₃ with NaOH in homogeneous aqueous solution has been studied by infrared measurements of the isotopic content of the haloform. Rate constants at 0, 20.1, and 35° and values of the heat and entropy of activation has been determined. The reaction appears to be only slightly subject to general base catalysis and has been found to proceed very nearly half as fast as the analogous reaction of CHCl₃ with NaOD in D₂O solution. (auth)

1834

THE VISCOSITY OF HYDROGEN AND DEUTERIUM AT PRESSURES UP TO 2000 ATMOSPHERES. A. Michels, A. C. J. Schipper, and W. H. Rintoul (Gemeente-Universiteit, Amsterdam, Netherlands). *Physica* **19**, 1011-28(1953) Oct. (In English)

The viscosity of H₂ and D₂ has been measured with the transpiration method at temperatures between 25 and 125°C at pressures up to 2000 atm. The results have been compared with the theoretical values obtained from the formulas of Enskog for dense gases. (auth)

1835

DEUTERIUM CONTENT OF NATURAL WATERS AND OTHER SUBSTANCES. Irving Friedman (Univ. of Chicago). *Geochim. et Cosmochim. Acta* **4**, 89-103(1953) Aug.

A mass spectrometric method for the accurate determination of the H-D ratio has been developed. It is possible to determine this ratio to ±0.10% using material of "normal abundance," i.e., 1 part D in 6700 parts H. Samples as small as 0.1 mg H₂ (0.001 ml H₂O) can be run. Natural evaporation and condensation that have been shown to fractionate the oxygen isotopes also fractionate the hydrogen isotopes. The ratio of these two fractionations is equal to the ratio between the ratios of the vapor pressures of H₂O/HDO and of H₂O¹⁶/H₂O¹⁸. Ocean waters range from 0.0153 to 0.0156 mole % D, whereas fresh waters of the United States range from 0.0133 to 0.0154 mole % D. A measurement of Yellowstone Park fumarole gases gives a minimum temperature of 400° for the equilibrium H₂O + HD = HDO + H₂ in the gases. (auth)

FLUORINE AND FLUORINE COMPOUNDS

1836

REACTIONS OF FLUOROCARBON RADICALS. PART XII. THE SYNTHESIS OF FLUOROCARBONS AND OF FULLY FLUORINATED IODO-, BROMO-, AND CHLOROALKANES. R. N. Haszeldine (Univ. Chemical Lab., Cambridge, England). *J. Chem. Soc.*, 3761-8(1953) Dec.

The reaction of trifluoriodomethane or of pentafluoroiodoethane with tetrafluoroethylene yields only CF₃·[CF₂·CF₂]_n·I or CF₃·CF₂·[CF₂·CF₂]_n·I. Isolation of the individual members of each series thus gives CF₃·[CF₂]_m·I (m = 2 to 15). The mechanism and control of the polymerization reaction are considered. The fluoriodoalkanes have been converted into the compounds CF₃·[CF₂]_m·X where X = H, Cl, Br, or F, and these compounds are compared with their unsubstituted (by fluorine) analogues. Perfluorocyclobutane and perfluorocyclopropane are by-products from the photochemical reactions of tetrafluoroethylene; the infra-red spectrum of the perfluorocyclopropane readily distinguishes it from the isomeric hexafluoropropene. (auth)

1837

PREPARATION AND REACTIONS OF PERFLUOROALKYL-LITHIUMS. O. R. Pierce, E. T. McBee, and G. F. Judd. (Purdue Univ., Lafayette, Ind.). *J. Am. Chem. Soc.* **76**, 474-8(1954) Jan. 20.

The conditions of formation of heptafluoropropyllithium and trifluoromethylolithium by interchange with butyl- or methylolithium have been studied, and an over-all yield of the perfluoropropyllithium reagent of 77% was obtained as shown by hydrolysis to heptafluoropropane. Reaction of this reagent with carbonyl compounds having an active hydrogen led to aldol-type products as well as the expected addition product, the best yield occurring with propionaldehyde (50%) and the lowest with benzophenone (0%). The scope and limitations of the reactions are discussed. (auth)

LABORATORIES AND EQUIPMENT

*1838

Oak Ridge National Lab.

AN IMPROVED FLUOROPHOTOMETER FOR DETERMINATION OF URANIUM IN FUSED SODIUM FLUORIDE PELLETS. M. T. Kelley, H. L. Hemphill, and D. M. Collier. Feb. 8, 1954. 21p. Contract W-7405-eng-26. (ORNL-1445)

An improved fluorophotometer for the measurement of the fluorescence of fused NaF pellets that contain U is described. This instrument consists of a compact optical system that requires no critical adjustments, a highly stable power supply for the photomultiplier tube, and a stable amplifier, which permits the use of a rugged meter for indicating the photocurrent. The instrument has a wide sensitivity range. (auth)

RADIATION CHEMISTRY

1839

THE CHEMICAL STATE OF ATOMS PRODUCED IN NUCLEAR TRANSMUTATIONS. An. N. Nesmeyanov, L. A. Sazonov, and I. S. Sazonova. Translated by F. L. Yaggee from *Uspekhi Khim.* **22**, 133-78(1953). 72p. (AEC-tr-1780)

An abstract of this paper appears in *Nuclear Science Abstracts* as NSA 7-5319.

RADIATION EFFECTS

1840

Brookhaven National Lab.

EVALUATION OF POLYETHYLENE CROSS LINKED BY IONIZING RADIATION. David S. Ballantine, G. J. Dienes, and B. Manowitz, Brookhaven National Lab. and Paul Ander and Robert B. Mesrobian, Polymer Research Inst., Polytechnic Inst. of Brooklyn. Dec. 18, 1953. 8p. (BNL-1677)

Changes resulting from the exposure of polyethylene to high energy γ rays from a Co⁶⁰ source are described. Data are tabulated on radioinduced changes in physical properties and infrared absorption bands. (C.H.)

*1841

Brookhaven National Lab.

GAMMA RAY POLYMERIZATION OF ACRYLAMIDE IN

THE SOLID STATE. Robert B. Mesrobian and Paul Ander, Polymer Research Inst., Polytechnic Inst. of Brooklyn and David S. Ballantine and G. J. Dienes, Brookhaven National Lab. [Jan. 15, 1954]. 6p. (BNL-1688)

Experiments are described which demonstrate that crystalline acrylamide undergoes polymerization upon irradiation with γ rays from an intense Co^{60} source. Below its melting point the monomer showed little or no tendency to polymerize thermally. (C.H.)

RARE EARTHS AND RARE-EARTH COMPOUNDS

*1842

Ames Lab.

CONDUCTANCES AND TRANSFERENCE NUMBERS OF SOME RARE EARTH PERCHLORATES, SULFATES AND NITRATES IN AQUEOUS SOLUTION. S. Jaffe and F. H. Spedding. June 1953. 126p. Contract W-7405-eng-82. (ISC-354)

The conductances and transference numbers of the perchlorates of La, Pr, Nd, Sm, Gd, Ho, Er, and Yb, of the nitrates of La, Nd, and Gd, and of the sulfates of La, Ce, Pr, Nd, Sm, Gd, Ho, Er, Yb, and Y were determined in aqueous solution at 25°C. The Jones bridge and its accessories were employed to measure the conductances over a concentration range of about 0.0002N to 0.1N. The perchlorate conductances appear to decrease with increasing atomic number except for La, Pr, and Nd. The three nitrates measured exhibit similar behavior to that of the perchlorates. However, the conductances of the perchlorates as a whole are higher than those of the nitrates except for very low concentrations. The conductances of the rare earth sulfates are much lower than expected for completely dissociated strong electrolytes. The rare earth sulfate conductances exhibit a far different order from that of the other salts measured. At appreciable concentrations the sulfate conductances decrease slightly from La to Pr and then rise a little at Nd. They fall again to a minimum at Sm and finally increase steeply from Sm to Yb. The transference numbers of the rare earth perchlorates and nitrates were measured by the moving boundary method. The accuracy of the method is estimated to be about 0.1%. The ionic conductances of the rare earth perchlorates and nitrates were calculated from the conductance data and the transference numbers. They provide a cross check with the conductances, since the ionic conductances of the anions fall on relatively the same curves. The use of the Onsager equation for the extrapolation of the conductances to infinite dilution indicated that a further correction on the conductances would give much better agreement with theory. This agreement was obtained when the extended Onsager equation was used. The extended equation includes a dependence on the mean distance of closest approach in the electrophoretic effect correction. This led to a method for determining the distances of closest approach for the rare earth perchlorates and nitrates from conductance data. The a_i values determined from the conductance data were quite reasonable and were used to calculate activity coefficients. The activity coefficients appear to be satisfactory and compare favorably with those of the rare earth halides which were determined from emf measurements. Since the activity coefficients for the rare earth perchlorates and nitrates are not available from experimental measurements, the conductance method affords a convenient and reasonably accurate method of obtaining them. (auth)

1843

Ames Lab.

METHODS FOR PRODUCING PURE RARE EARTH METALS AS DEVELOPED AT IOWA STATE COLLEGE. F. H. Spedding and A. H. Daane. [Jan. 14, 1954]. 13p. Contract W-7405-eng-82. (ISC-442)

Electrolytic and metallothermic methods are described for preparing the rare earth metals. Some properties of some of these metals are given, including melting points, transition temperatures, vapor pressures, heats of vaporization, crystal structures, electrical resistivities, heat capacities, and magnetic properties. (auth)

1844

Ames Lab.

METHODS FOR SEPARATING RARE EARTH ELEMENTS IN QUANTITY AS DEVELOPED AT IOWA STATE COLLEGE. F. H. Spedding and J. E. Powell. [Jan. 25, 1954]. 21p. Contract W-7405-eng-82. (ISC-444)

Three district processes involving ion-exchange resins have been developed which have been exceptionally efficient in producing quantities of individual rare earths in a high state of purity. The first method is the elution of an adsorbed band of mixed rare earths down a cation-exchange bed in the H or ammonium state by means of a 5% citric acid solution adjusted to a pH of 2.5 to 3.0 with NH_4OH . The second method is the elution of an adsorbed band down a cation-exchange resin bed in the hydrogen state with a 0.1% citric acid solution adjusted to a pH of 5.0 to 8.0 with NH_4OH . The third method consists of the elution of an adsorbed band of rare earths through a cation-exchange bed in the Cu II cycle with an ammonium salt of (ethylenediaminetetra)acetic acid. The three methods are compared, and it is concluded that the third method is more desirable and economical than the citrate methods for separating the more difficult groups of rare earths. (J.S.R.)

1845

CONDUCTANCES, TRANSFERENCE NUMBERS AND ACTIVITY COEFFICIENTS OF AQUEOUS SOLUTIONS OF SOME RARE EARTH CHLORIDES AT 25°. F. H. Spedding and J. L. Dye (Iowa State College, Ames). *J. Am. Chem. Soc.* 76, 879-81(1954) Feb. 5.

The equivalent conductances, cation transference numbers, and activity coefficients at 25° of aqueous solutions of DyCl_3 , HoCl_3 , and TmCl_3 have been determined for concentrations up to 0.1N. Since the rare earth elements undergo a slight amount of hydrolysis, which becomes more evident for the heavier members of this series, the measurements were made on solutions at the equivalence pH. The equivalence pH was determined by acid titration of the solutions. To determine whether the hydrolysis has a measurable effect upon the properties, the measurements were repeated for solutions of NdCl_3 , ErCl_3 , and YbCl_3 at the equivalence pH. The slight deviation from equivalence shown by solutions which were prepared by dissolving the anhydrous chloride, as prepared, in water in a closed system, was found to have a negligible effect upon the properties of solutions of the light rare earth chlorides, but exceeded the experimental error by a small amount for the heavier rare earth chlorides. (auth)

1846

THE APPLICATION OF ONSAGER'S THEORY OF CONDUCTANCE TO THE CONDUCTANCES AND TRANSFERENCE NUMBERS OF UNSYMMETRICAL ELECTROLYTES. J. L. Dye and F. H. Spedding (Iowa State Coll., Ames). *J. Am. Chem. Soc.* 76, 888-92(1954) Feb. 5.

Consideration of the transference number behavior of unsymmetrical electrolytes in aqueous solution led to an examination of the mathematical development of Onsager's theory of conductance. A mathematical treatment of Onsager's theory of conductance is described, which employs graphical methods to evaluate integrals which were only approximately evaluated by Onsager. The approximate methods, while satisfactory for 1-1 electrolytes, are unable to explain the transference number behavior of unsymmetrical electrolytes. The new treatment of the theory

was applied to the conductances and transference numbers of CaCl_2 , NdCl_3 , and ErCl_3 . The agreement between theory and experiment was greatly improved for both transference numbers and conductances of these unsymmetrical electrolytes. (auth)

1847

COMPLEX FORMATION AND TERM SPLITTING IN THE ABSORPTION SPECTRA OF THE RARE EARTHS. Ludwig Holleck and Dietrich Eckardt (Universität Hamburg, Germany). *Z. Naturforsch.* **a8**, 660-4(1953) Oct. (In German)

It is shown that the course of complex formation in aqueous solutions of the rare earths can be followed by absorption spectroscopy measurements of term splitting. As an example, the 5750 Å line of Nd gives a distinct characteristic term splitting picture. The appearance of different complexes can be followed by the change of H ion concentration in the solution as well as by the change of the ratio of the rare earths to the complex formed. In the course of the progressive pH change intermediate complexes of even symmetry were found in α -cyclohexanediamine- N, N' -tetraacetate and ethylenediamine, in which different splitting forms of the end complexes occur. The intermediate complexes can be explained by the similarity of structure and the slight disorientation possibility. In Pr, as well as in Sm, term splitting was found to be of the same order of magnitude as that of Nd. In the citrate complex of Pr the ground term splitting was determined to be 220 to 230 cm^{-1} . (tr-auth)

1848

SYSTEMATIC VARIATION OF RARE EARTHS IN MONAZITE. K. J. Murata, H. J. Rose, Jr., and M. K. Carron (U. S. Geological Survey, Washington, D. C.). *Geochim. et Cosmochim. Acta* **4**, 292-300(1953) Dec. (In English)

Ten monazites from widely scattered localities have been analyzed for La, Ce, Pr, Nd, Sm, Gd, Y, and Th by means of a combined chemical and emission spectrographic method. The analytical results, calculated to atomic percent of total rare earths (Th excluded), show a considerable variation in the proportions of every element except Pr, which is relatively constant. The general variation trends of the elements may be calculated by assuming that the monazites represent different stages in a fractional precipitation process that there is a gradational increase in the precipitability of rare earth elements with decreasing ionic radius. Fractional precipitation brings about an increase in La and Ce, little change in Pr, and a decrease in Nd, Sm, Gd, and Y. Deviations from the calculated lines of variations consist of a simultaneous, abnormal increase or decrease in the proportions of Ce, Pr, and Nd with antipathetic decrease or increase in the proportions of the other elements. These deviations are ascribed to abnormally high or low temperatures that affect the precipitability of the central trio of elements (Ce, Pr, Nd) relatively more than that of the other elements. The following semiquantitative rules have been found useful in describing the composition of rare earths from monazite: the sum of La and Nd is very nearly a constant at 42 ± 2 at. %, Pr is very nearly constant at 5 ± 1 at. %, and the sum of Ce, Sm, Gd, and Y is very nearly a constant at 53 ± 3 at. %. No correlation could be established between the content of Th and that of any of the rare earth elements. (auth)

SEPARATION PROCEDURES

1849

SEPARATION OF ALKALI IONS WITH ION EXCHANGER AND KOMPLEXON. W. Buser. Translated by H. A. Schmitt from *Helv. Chim. Acta* **34**, 1635-41(1951). 9p. (AEC-tr-1778)

An abstract of this paper appears in *Nuclear Science Abstracts* as NSA 5-6168.

SPECTROSCOPY

1850

Los Alamos Scientific Lab.

POLARIZED INFRARED SPECTRUM OF $\text{KAu}(\text{CN})_2$: REVISION AND REFINEMENT. Llewellyn H. Jones. [1953] 4p. Contract W-7405-Eng-36. (AECU-2799)

1851

Los Alamos Scientific Lab.

INFRARED SPECTRA OF CH_3COONa AND CD_3COONa AND ASSIGNMENTS OF VIBRATIONAL FREQUENCIES.

Llewellyn H. Jones and Eugene McLaren. [nd]. 13p. Contract W-7405-eng-36. (AECU-2802)

The absorption spectra of solid CH_3COONa and CD_3COONa were observed from 350 to 5000/ cm . All of the fundamental frequencies of the acetate ion have been observed and assigned with the exception of that of the torsional oscillation. The assignments for CH_3NO_2 and CD_3NO_2 were used as an aid in assigning the CH_3CO_2^- and CD_3CO_2^- frequencies. An approximate force constant, 9.3×10^5 dynes/cm, is given for the C-O bond of CH_3CO_2^- in solid Na acetate. (auth)

1852

THE INFRARED SPECTRA OF PROPYLENE AND PROPYLENE- d_6 . R. C. Lord and Putcha Venkateswarlu (Mass. Inst. of Tech., Cambridge). *J. Opt. Soc. Amer.* **43**, 1079-85(1953) Nov.

The infrared spectrum of propylene has been obtained under somewhat higher resolution than that used by previous workers. The improved resolution enables the assignment of many bands on the basis of the band types of the nearly symmetrical top. No important changes are made in existing assignments. The spectrum of propylene- d_6 has been obtained. From an overtone band the unobserved torsional frequency is located at 174 cm^{-1} in propylene and at about 130 cm^{-1} in propylene- d_6 . (auth)

URANIUM AND URANIUM COMPOUNDS

*1853

Hanford Works

MICROTITRATION OF FREE ACID IN URANYL NITRATE SOLUTIONS. W. N. Carson, Jr. Oct. 1, 1953. Decl. Jan. 26, 1954. 22p. Contract W-31-109-Eng-52. (HW-29455)

Several new microtitrations of the free acid in $\text{UO}_2(\text{NO}_3)_2$ solutions have been developed. It was found that two methods of titration would cover the range (for 10- μl samples): 0.2M HNO_3 to any obtainable HNO_3 molarity and 0.0M UNH to 2.0M UNH. The methods, however, are not suitable if the sample contains dichromate, permanganate, or appreciable amounts of other hydrolyzable cations, such as Al. The precision of the acid values varies with the method and the concentration of HNO_3 and UNH. For medium-to-high (>0.5M) acid concentration, the precisions (95% limits) are below $\pm 7\%$. For low acid concentrations (<0.5M), the precisions are below 10%. In addition to the general methods, special titrations which are suited to a limited number of samples were found. Several of these methods offer a possibility of an alkalimetric determination of U by titrating the acid released by hydrolysis. Another special method can be used for microtitration of acid in the presence of phosphates as well as U. (auth)

1854

APPLICATION OF THE METHOD OF RaD TO THE MEASUREMENT OF THE "CHEMICAL" AGE OF A MINERAL OF URANIUM. F. Begemann, H. V. Buttler, F. G. Houtermans (Univ. of Göttingen, Germany), N. Isaac, and E. Picciotto (Univ. Libre de Bruxelles, Belgium). *Geochim. et Cosmochim. Acta* **4**, 21-35(1953) Aug. (In French)

The RaD method suggested by F. G. Houtermans for the determination of the "chemical" age of U minerals consists in the measurement of Pb/U, from the ratio RaD/Pb. Since

RaD is an isotope of Pb, this ratio can be determined on any quantity of Pb from the mineral. In this way the quantitative analyses of U and Pb are avoided. The determination can be carried out on an extremely small quantity of matter. The conditions under which the method is applicable and the ways of measuring RaD are discussed. A confirmation has been obtained with two samples of pitchblende from Shinkolobwe: the ratio Pb/U was determined on the one hand by chemical analysis, and on the other by the RaD method. All the measurements of the two methods were carried out independently at the second Physical Institute of the University of Göttingen, and at the Centre de Physique Nucléaire de l'Université Libre de Bruxelles. One method of Pb determination by dithizone extraction and polarography is described in detail. The technique of measuring the RaD by counting the β particles of RaE was perfected. The ratios Pb/U determined by the two methods agree within the experimental errors. The advantages of the RaD method are summarized in the conclusion. (auth)

ENGINEERING

1855

Boeing Airplane Co.
STIFFNESS OF CURVED CIRCULAR TUBES WITH INTERNAL PRESSURE. Paul G. Kafka and Maurice B. Dunn. July 27, 1953. 38p. Contract AF-33(038)-25915. (D-14025)

AEROSOLS

*1856

Little, Arthur D., Inc.
SURVEY OF AIR SAMPLING MEDIA AND SAMPLING METHODS USED AT A.E.C. AREAS AND BY OTHERS. Sept. 1953. 5p. (AECU-2796)

Data are tabulated on air filter media, sampling conditions, sampling devices, aerosols collected, and analytical methods used at AEC and other selected laboratories. (C.H.)

*1857

Oak Ridge National Lab.
ELECTROSTATIC PRECIPITATOR FOR MEASURING PARTICLE-SIZE DISTRIBUTION IN AEROSOLS. Bernard G. Saunders. Feb. 8, 1954. 24p. Contract W-7405-eng-26. (ORNL-1656)

An electrostatic precipitator has been constructed that sorts smoke particles according to size. Attempts to calibrate it for size distribution have so far been unsuccessful. (auth)

*1858

Oak Ridge National Lab.
SOLID AEROSOL GENERATION. W. D. Cottrell. Feb. 5, 1954. 26p. Contract W-7405-eng-26. (ORNL-1666)

The problem under investigation was that of generating a solid homogeneous aerosol in sufficient concentration to permit its use as a test aerosol. The method of approach was that of generating an aerosol of homogeneous liquid droplets from a suitable solution and drying the droplets to form solid particles of the solute. Several types of generators were investigated with the most promising being a high speed air top. The air top was rotated at speeds up to approximately 100,000 rpm and gave liquid droplets as small as 20μ in diameter. The minimum size of solid particles that could be produced from these liquid droplets was not determined. (auth)

HEAT TRANSFER AND FLUID FLOW

1859

THE FLOW OF LIQUID-GAS MIXTURES IN VERTICAL TUBES. Hans Behringer. Translated by H. A. Schmitt from *Z. ges. Kälte-Ind.* 43, 55-8(1936). 7p. (AEC-tr-1777)

The characteristics of flow of liquid-gas mixtures in large pumps and vertical-tube boilers is explained by resolving the velocity with which bubbles move through the tube into its two components. The origin and behavior of these components are described. (auth)

1860

THE EFFECT OF VELOCITY OF MOTION OF A FLUID ON HEAT TRANSFER DURING BOILING. N. G. Styushchin and L. S. Sterman. Translated by Morton Hammermesh from *Zhur. Tekh. Fiz.* 21, 448-52(1951). 6p. (AEC-tr-1781)

An abstract of this paper appears in *Nuclear Science Abstracts* as NSA 5-5641.

1861

TRANSIENT THERMAL STRESSES IN SLABS AND CIRCULAR PRESSURE VESSELS. M. P. Heisler (North American Aviation, Inc., Downey, Calif.). *J. Appl. Mechanics* 20, 261-9(1953) June.

The results of computations for determining transient thermal stresses in slabs and circular pressure vessels are presented. The process of solution adopted is to substitute transient-temperature formulas into the already available stress expressions. The expressions for thermal shock are transformed by means of a simple integral theorem into a form appropriate for analyzing the thermal processes commonly used to relieve thermal shock. A new dimensionless stress parameter is defined and applied to the determination of optimum heating or cooling times of massive pressure vessels. (auth)

MATERIALS TESTING

1862

NON-DESTRUCTIVE DETERMINATION OF DOUBLINGS IN PLATES. W. Jellinghaus and F. Staebelin. Translated by H. A. Schmitt from *Tech. Mitt. Krupp A. Forschungsber.* 4, 31-6(1941). 7p. (AEC-tr-1772)

An electric process for the determination of doublings in plates is outlined. A doubling causes an increased resistance against a current crossing the plate in a diagonal direction, thus leading to its discovery. Above the plate to be tested a net of checkpoints is superimposed which determines the diagonal resistance between two points facing each other from opposite sides of the plate. The resistance is fixed by means of measuring current and tension. (J.E.D.)

1863

TESTING OF A MAGNET-INDUCTIVE TESTING DEVICE, CONSTRUCTED BY DR. SCHIRP, FOR ACCEPTANCE TESTING OF LIGHT METALS. E. K. O. Schmidt and H. Muster. Translated by H. A. Schmitt from *Aluminium* 25, 110-12(1943). 6p. (AEC-tr-1774)

The magnet-inductive feeler-coil device is suitable for differentiation between hardened and nonhardened parts of refinable Al alloys, as well as for the distinction between the various other Al alloys. It can also be used for the sorting of insufficiently hardened parts during current acceptance testing in place of the Brinell determination of hardness. (auth)

1864

ACCEPTANCE TESTING OF ALUMINUM ALLOYS WITH THE ELECTRO-INDUCTIVE TESTING DEVICE OF DR. SCHIRP. Kurt Matthes. Translated by H. A. Schmitt from *Aluminium* 25, 106-10(1943). 7p. (AEC-tr-1775)

The electroinductive procedure for testing metals is

based on the difference in electric conductivity of the samples tested. By means of a testing coil fed with a-c of medium frequency, whirling currents which react on the coil are created in the sample tested. By comparing the resistance of the testing coil with that of the comparison coil or with an adjustable rheostat, small differences in the conductivity can be shown with the aid of an a-c arc. (J.E.D.)

1865

EXPERIMENTS WITH SUPERSONIC SOUND IN THE TESTING OF METAL, CASTINGS, AND CERAMICS. A. Dietzel. Translated by C. Baumgardner from *Ber. deut. keram. Ges.* **28**, 299-302(1951). 8p. (AEC-tr-1779)

An attempt was made to substantiate the interior defects (cracking, blistering, imbedded defects, etc.) in enameled metals, various types of cast Fe, and ceramic slabs by means of supersonics. The construction and method of operation of the Pohlman apparatus which was used are described. It was shown that the so-called nonhomogeneity in enameled metals can be made clearly visible and recognizable. The procedure is therefore suitable for the critical examination of the ability of the metals to be enameled and is free of disturbances and quickly done. Cast Fe and porous ceramic matter are not easily examined for defects or enclosed flaws, inasmuch as their structural character (due to graphite veins or pores) is too non-homogeneous for the use of supersonic sound waves. In comparison, dense (non-porous) ceramic materials would be well suited for examination with supersonic sound. (auth)

1866

THE NON-DESTRUCTIVE TESTING OF LIGHT METALS WITH THE AID OF A FEELER COIL. F. Foerster and H. Breitfeld. Translated by H. A. Schmitt from *Aluminium* **25**, 253-6(1943). 6p. (AEC-tr-1782)

The method of testing consists primarily of measuring the electric conductivity of the sample to be tested. The development of an inductive testing device with interference-free reading is reported. (J.E.D.)

1867

NON-DESTRUCTIVE CONTROL OF MATERIALS. NEW DYNAMIC METHOD FOR MEASURING THE CONSTANTS OF ELASTICITY. R. Cabarat. Translated by Yolande Fantino from *Metaux(Corrosion-Inds.)* **26**, 126-30(1951). 11p. (AEC-tr-1784)

The measurement of the constants of elasticity of solid materials was made by studying the longitudinal vibrations of cylindrical test bars. The method proposed, consisting of an a-c field, permits the excitation and measurement of vibrations of all substances which are sufficiently good conductors. In the case of a dielectric, the presence of a thin conducting coating on the surface of the test bar does not change the mechanical properties of the materials appreciably and allows the maintenance of the vibrations. The method also permits measurement of the internal friction. (J.E.D.)

1868

NON-DESTRUCTIVE TESTING ON ELECTRICAL BASIS. F. Foerster and H. Breitfeld. Translated by H. A. Schmitt from *Aluminium* **25**, 130-3(1943). 6p. (AEC-tr-1785)

The electric method for nondestructive testing of materials by the whirling current process is described. In principle the whirling current process permits direct measurement of the electric conductivity and accuracy as to size of the sample. (J.E.D.)

PUMPS

1869

Atomic Energy Research Establishment, Harwell, Berks (England)

AN AUTOMATIC TÖPLER PUMP. W. J. Arrol and E. J. Wilson. Nov. 17, 1953. 6p. (AERE-I/M-30)

The construction and performance of a Pyrex glass automatic Töpler pump for use in high-vacuum apparatus are described. (auth)

*1870

Radiation Lab., Univ. of Calif., Berkeley
SOME MEASUREMENTS ON A HIGH-VACUUM HIGH-SPEED ION PUMP (thesis). John Stuart Foster, Jr. Aug. 17, 1953. 67p. Contract W-7405-eng-48. (UCRL-2312)

A vacuum pump has been developed in which gas particles are ionized and delivered to a higher-pressure region by magnetic and electric fields. The active element is a discharge which is collimated by a magnetic field of about 1300 gauss. The discharge is terminated at one end by a hot W cathode and at the other end by a cold reflecting cathode. Gas enters the discharge through an open-wound helix section at anode potential. A current of 5000 amps is passed through the helix to maintain the axial magnetic field in this region. Ions formed in the discharge are confined radially by the magnetic field and are delivered by the normal plasma gradient to the cathode where they are neutralized and can be removed by a backing pump. The pressure in this region can be as high as 10^{-2} mm Hg. No backing pump is required for gas flows of less than 0.02 cc/sec NTP, except for the noble gases. Pumping speeds of 3000 to 7000 l/sec and a base pressure of 10^{-6} mm have been obtained. Measurements have been made to determine some of the factors that limit the performance. Operation is automatic, and continuous running has been obtained for periods of at least two weeks. (auth)

1871

THE EXTERNAL FRICTION OF GASES AND A NEW PRINCIPLE FOR VACUUM PUMPS: THE MOLECULAR VACUUM PUMP. W. Gaede. Translated from *Phys. Z.* **13**, 864-70(1912). 12p. (AEC-tr-1751)

It was observed that at pressures greater than 0.001 mm Hg a film of gas forms on a glass surface with the result that the molecules are reflected preferentially toward the direction from which they came. The experiment indicated that the glass surface contains two types of inequalities, mechanical and molecular. At pressures above 0.001 mm the molecular inequalities are covered by a layer of gas, the permeability of which increases with the distance from the wall. Molecules reflected from the wall must first penetrate this layer of gas, and this influences the angle of reflection. The existence of a gas layer reduces the quantity of gas flowing through a tube per unit of time or increases the hydrodynamic external friction between gas and wall. (J.E.D.)

MINERALOGY, METALLURGY, AND CERAMICS

CERAMICS AND REFRACTORIES

1872

AN EVALUATION OF THE USE OF THE REFRACTORY OXIDES Al_2O_3 AND SiO_2 IN ELIMINATING A GAS-PRODUCED ENAMEL DEFECT. Richard G. Rion (Clemson Coll., Clemson, S. C.). *Am. Ceram. Soc. Bull.* **33**, 16-20 (1954) Jan.

Studies were made on the effect of the refractory oxides alumina and silica on the elimination of gas-produced enamel defects and also on such properties as adherence, refractoriness, texture, and bubble structure of the resulting ground

coat. It was found that mill additions of alumina and silica in larger than normal amounts did not completely eliminate reboiling, but there is a small area of compositions of these two oxides which minimize the tendency to reboil. It was also found that use of a greater than normal amount of alumina and silica was effective in eliminating delayed fishscaling. (auth)

1873

PHASE EQUILIBRIA IN THE SYSTEM LITHIUM METASILICATE- β -EUCRYPTITE. M. Krishna Murthy and F. A. Hummel (Pennsylvania State Coll., State College). *J. Am. Ceram. Soc.* **37**, 14-17(1954) Jan.

A phase equilibrium study of the join Li metasilicate- β -eucryptite in the system $\text{Li}_2\text{O}-\text{Al}_2\text{O}_3-\text{SiO}_2$ was made by the quench method. The phase diagram was found to be a simple binary with a eutectic at 1070°C and 57% eucryptite. The relationship of these data to the ternary system is discussed. (auth)

1874

PROPERTIES OF A TIN OXIDE-BASE CERAMIC BODY. John Quirk and C. G. Harman (Battelle Memorial Inst., Columbus, Ohio). *J. Am. Ceram. Soc.* **37**, 24-6(1954) Jan.

Some thermal and mechanical properties were measured for SnO_2 matrix compacts which nominally were composed of 99 wt. % SnO_2 and 1 wt. % ZnO . The sintered compacts were similar in strength to high-fire mullite porcelains, had superior resistance to thermal shock, and had high thermal conductivity. The SnO_2 body might be expected to give good service under conditions of severe thermal shock and in an oxidizing atmosphere at temperatures up to 1500°F. (auth)

CORROSION

*1875

Stanford Univ. School of Mineral Sciences
INVESTIGATION OF MATERIALS FOR USE IN A HEAT TRANSFER SYSTEM CONTAINING LIQUID LEAD OR BISMUTH. O. Cutler Shepard, James R. Morgan, Ralph Parkman, and Richard D. Seibel. Dec. 31, 1953. 41p. Contract AT(11-1)-190, Report No. 15. (AECU-2794)

The effects of Ti and Si addition to liquid Bi and the possible mechanisms of Ti inhibition of Fe and Cr solution from corrosion of 410 stainless steel are reported. The variables studied were amount of Ti, form in which Ti is introduced, duration of exposure to liquid metal, temperature of exposure, effects of precoating the steel surfaces, effects of cycling temperature between rather widely separated values, and amount of Si. Control runs indicated that the dissolution of Fe was temperature dependent and that of Cr was both time and temperature dependent. TiH_2 markedly inhibited Cr solution but only slightly inhibited Fe solution, which was subject to much variation. Ti metal inhibited both Fe and Cr solution but was much less effective for the Fe. Multiple use of the steel capsules showed an appreciable further reduction in both Fe and Cr solution. At all temperatures tested Ti metal appeared more effective in the inhibition of Fe and Cr solution than did the hydride. Thermal cycling appeared to have no effects. Si had only a slight beneficial effect at concentrations in the range 50 to 150 ppm and a harmful effect at higher concentrations. The mechanism of Ti inhibition has not been demonstrated experimentally. Solubility of O_2 in Bi increases with increase of temperature. Attempts are being made to construct a device for measuring wetting so that the relation between corrosion and wettability can be ascertained. (For preceding report in series see AECU-2549.) (J.S.R.)

*1876

Argonne National Lab.
AQUEOUS CORROSION OF 2S ALUMINUM AT ELEVATED

TEMPERATURES. J. E. Draley and W. E. Ruther. Feb. 1, 1953. 41p. Contract W-31-109-Eng-38. (ANL-5001)

2S aluminum corrodes uniformly in nearly pure water at rates which increase with temperature. The reaction is characterized by an initial period of relatively rapid corrosion, followed by a linear slow rate of corrosion. The slope of the linear part of the curve, or the corrosion rate, changes from about 0.05 to 1.3 mil/yr average penetration rate from 125 to 200°C. Above 200°C intergranular attack occurs, with resultant more rapid penetration and deterioration of the metal. The corrosion rate can be reduced and apparently the intergranular attack can be prevented by the addition of an acid to the water. The solution pH of minimum corrosive attack on Al goes down with increasing temperature. It is of the order of 6.5 at 50°C and 2 at 315°C. At all temperatures above the boiling point of water the corrosion rate is less in dilute acid solutions than in neutral water. Sulfuric acid has generally been used for adjusting the acidity of water. Presumably other acids would be satisfactory except that no halogen ions should be added. Corrosion in slightly alkaline solutions (pH 8.5) is more rapid than in neutral water at nearly all temperatures. At 100°C the difference shown in stagnant tests is very slight but increases considerably if the temperature is increased to the order of 200°C. Presumably the effect of solution flow rate would be marked in the case of alkaline water; much more so than in neutral water. The corrosion of 2S Al does not appear to eliminate it as a material of construction in contact with pure water up to about 200°C. In dilute acid, properly controlled, it is probable that Al could be used to considerably higher temperatures. The temperature limitation has not yet been determined in this environment. (auth)

1877

Metallurgical Lab., Engineering Experiment Station, Annapolis
CORROSION TESTS OF SIXTEEN MATERIALS IN 500°F WATER AT HIGH AND LOW VELOCITIES. C. J. Lancaster. Nov. 18, 1952. 26p. (EES-4A(21)966870)

Results of corrosion tests are reported for 16 constructional materials which were exposed at two velocities, 10 ft/sec and 1 ft/hr, in water at 500°F containing 20 to 30 ml of O_2 per liter. The high-velocity tests were continued for 90 days and the low-velocity tests for 60 days. All materials were tested in the form of flat tension specimens which were not stressed during test. Specimens tested at high velocity were mounted in special slotted holders of austenitic Cr-Ni steel which minimized contact corrosion. Specimens tested at low velocity were mounted on 18-8 rods with $\frac{1}{16}$ -in. washers of similar material for separating the specimens. Contact corrosion developed at these washers in most instances. Results of test are evaluated on the basis of appearance and weight change. (auth)

GEOLOGY AND MINERALOGY

1878

Washington and Lee Univ.
REPORT OF GEOLOGICAL RECONNAISSANCE IN SOUTH-CENTRAL MONTANA AND NORTHWESTERN WYOMING. Marcellus H. Stow. Dec. 1953. 34p. Contracts AT(49-1)-860 and AT(49-1)-860, Mod. No. 1. (RME-3069)

Reconnaissance in south-central Mont. and selected areas in northwestern Wyo. indicated that the following areas are devoid of radioactive minerals: the Cenozoic, Mesozoic and Upper and Middle Paleozoic sedimentary formations of southeastern Wheatland, southern Golden Valley, west-central Yellowstone, Stillwater, eastern Sweet Grass, Carbon, and eastern Big Horn counties, Mont., the Livingston volcanics of Sweet Grass and Stillwater counties, Mont., the mineralized igneous intrusions and volcanics

of the Deer Creek-McLeod district, and the Crazy Mountains, Sweet Grass Co., Mont., and the Sunlight Mining District, Park Co., Wyo.; the metalliferous deposits associated with the Stillwater complex, Stillwater and Carbon counties, Mont. Fossil bones of Paleocene and Cretaceous animals in the area examined have not been mineralized with radioactive materials. Very slight radioactivity is present in certain metalliferous deposits associated with Pre-Cambrian crystalline rocks, viz., the 4-7's Claim and the Counts property, Park Co., Mont. Substantial radioactivity is present in at least one metalliferous deposit associated with Pre-Cambrian crystalline rocks, viz., the Hart Claim at Goose Lake, Park Co., Mont. The most significant conclusion that has been derived from the investigations is that there is an important relationship between faulting and radioactive mineralization near the contact of the basal (Flathead sandstone) member of the Cambrian sediments and Pre-Cambrian granite. (auth)

1879

THE ABUNDANCES OF Li, Sc, Sr, Ba AND Zr IN CHONDRITES AND SOME ULTRAMAFIC ROCKS. W. H. Pinson, L. H. Ahrens, and Mona L. Franck (Mass. Inst. of Tech., Cambridge). *Geochim. et Cosmochim. Acta* **4**, 251-60(1953). Nov. (In English)

Quantitative spectrochemical determinations of Li, Sc, Sr, Ba, and Zr in 21 specimens of chondrite, 7 other silicate meteorites, and 13 ultramafic rocks are presented and discussed. Abundances in chondrites have been determined as: Li (2.7 ppm), Sc (6 ppm), Sr (11 ppm), Ba (8 ppm), and Zr (33 ppm). Each element shows a high degree of uniformity of abundance; distribution is possible lognormal. β -activity of Rb^{87} is calculated to generate ~13% of total Sr^{87} in chondrites. (auth)

METALS AND METALLURGY

1880

Metal Research Lab., Case Inst. of Tech.

THE FLAKING OF STEELS. A LITERATURE SURVEY ON THE MECHANISM OF FLAKE FORMATION. F. J. Short-sleeve and A. R. Troiano. Jan. 15, 1953. 135p. Contract No. DA-33-019-ORD-897, Interim Technical Report No. 1. (AD-13221)

A critical survey of the literature on the mechanism of flaking is presented. Opinions of various investigators are discussed concerning the effects of rolling and forging stress, nonmetallic inclusions and segregation, time and temperature of flake formation, the effect of H, and transformation stresses. (J.E.D.)

*1881

Armour Research Foundation

PHASE DIAGRAMS OF ZIRCONIUM-BASE BINARY ALLOYS. REPORT NO. 13. THE ZIRCONIUM-NITROGEN SYSTEM. REPORT NO. 3. OCTOBER 1, 1953-DECEMBER 31, 1953. R. F. Domagala and D. J. McPherson. Dec. 31, 1953. 11p. Contract AT-(11-1)-149. (COO-189)

Progress of the work on the preparation of the N-Zr system is reported. Metallographic examination of annealed samples is discussed. Results of the nitriding experiments and annealing schedule of N-Zr systems are tabulated. Analytical data on the systems are presented. (For preceding period see COO-188.) (J.E.D.)

*1882

Hanford Works

A REPLICA PRESS ATTACHMENT FOR THE PRECISION MOUNTING PRESS FOR USE IN PREPARING ALUMINUM REPLICAS OF THE SURFACES OF IRRADIATED MATERIALS. W. E. Roake. Oct. 21, 1953. 15p. Contract W-31-109-eng-52. (HW-30156)

A replica press has been designed and constructed. The

press was designed to be used in conjunction with a remotely operated shielded precision mounting press (Model 87712) for compressing an annealed high-purity Al billet against the surface of a polished and etched sample of irradiated metal which previously had been mounted with Precipilonite Molding Powder in the same mounting press. The replica press has been tested on samples of unirradiated U. (auth)

*1883

Knolls Atomic Power Lab.

THERMAL STRESSES IN RECTANGULAR STRIPS. PART 1. G. Horvay and J. S. Born. Oct. 20, 1953. 73p. Contract W-31-109-eng-52. (KAPL-1001)

Stresses and deformations ensuing from the application of a step-function temperature distribution $\theta(x)$ to a rectangular strip are calculated. (For $x < 0$, $\theta = T$; for $x > 0$, $\theta = 0$. The strip extends from $x = -\infty$ to $x = +\infty$.) While popular belief holds that the permitted temperature step T is related to the design stress σ_d by $E\alpha T/2 = \sigma_d$ (since this is the magnitude of the transverse stress σ_y that develops at the cross section $x = \pm 0$), it is shown in the paper that $E\alpha T = \frac{1}{6} \sigma_d$ is the correct relation. The reduction in the permitted temperature step is caused by the occurrence of rather large shear stresses in the critical cross section. The stresses decay very rapidly on the two sides of $x = 0$; they become insignificant well within a strip-width distance of the origin. The results of the analysis are represented pictorially in the form of stress surfaces and deformation surfaces over the strip. The theoretical implications of the analysis are no less interesting than the practical conclusions. It is shown that the stresses and deformations in the strip may be derived from an Airy function

$$\phi(x,y) = E\alpha T \cdot R \sum \frac{\sin^2 z}{\cos^2 z} \phi_n;$$

$$\phi_n = \frac{e^{-z_n x}}{z_n^2} (\cos z_n y - y \cot z_n \sin z_n y)$$

where the summation is over all first quadrant roots ($R(z) > 0$) of $\sin 2z + 2z = 0$. The functions $\phi_n(x,y)$ are Fadde's biharmonic eigenfunctions. This is the first time, to the authors' knowledge, that, in a nontrivial problem, a precise expansion into biharmonic eigenfunctions has been obtained. Nevertheless, the convergence of the precise expansion for small x is found to be so poor that the much simpler, though approximate, method of self-equilibrating functions remains the superior technique to be used in all problems of this kind. This was borne out by comparing the results of the two types of series, each terminated after four terms, with numerically evaluated infinite Fourier integrals. Results are tabulated for stresses and deformations so as to facilitate superposition of the results for more complex temperature distributions. (auth)

*1884

Livermore Research Lab., Calif. Research and Development Co.

THERMOELECTRIC CALIBRATION OF ZIRCONIUM-CONSTANTAN AND ZIRCONIUM-ALUMEL THERMOCOUPLES. C. J. Shoens and J. W. Shortall. Issued Dec. 1953. 17p. Contract AT(11-1)-74. (LRL-62)

Data are presented in tabular form on the calibration of Zr-constantan and Zr-alumel thermocouples from zero to 600°C. Statistical analyses of the data show that the emf vs. temperature values obtained in this experiment should be accurate to $\pm 2^\circ\text{C}$ in the first case and $\pm 5^\circ\text{C}$ on the average in the latter case. (auth)

1885

[Division of Atomic Energy (Production)] Research and Development Branch, Windscale (England)
INVESTIGATION ON THE WELDING OF 1-INCH N.B.

18/13/1 STAINLESS STEEL PIPE BY THE HOT PRES-SURE WELDING METHOD. C. O'Grady, E. K. Richardson, and D. R. Mackey. June 30, 1952. 17p. (RDB(W)/36)

1886

General Electric Research Lab.

FUNDAMENTAL RESEARCH IN PHYSICAL METALLURGY. TWENTIETH QUARTERLY REPORT. (PROGRESS REPORT NO. 37). J. H. Hollomon and D. Turnbull. Jan. 5, 1954. 7p. Contract W-31-109-Eng-52. (SO-2031; RL-1037)

The ratio R of the self-diffusion coefficient of Ag containing 1 at. % of solute to the self-diffusion coefficient of pure Ag is reported for several solute metals. At a temperature of 750°C, $R_{Pb} = 2.00$, $R_{Ge} = 1.50$, $R_{Al} = 1.15$, $R_{Cu} = 1.10$, where the subscript R refers to the solute metal. These results, particularly R for Al, cannot be entirely explained by the disparity between the atomic radius of the pure solute and that of Ag. The conclusions of the thermodynamic investigation on solid Cu-Au alloys around the 50-50 atomic composition are given. The increase in solution entropy of Au-Ni alloy (approximately 50-50 atomic composition) over the temperature range 273 to 1193°K was found to be 0.14 cal/(g atom deg). (For preceding period see SO-2030.) (auth)

1887

Battelle Memorial Inst.

BRAZING TITANIUM TO TITANIUM AND TO MILD AND STAINLESS STEELS. W. J. Lewis, G. E. Faulkner, P. J. Rieppel, and C. B. Voldrich. Dec. 1953. 57p. Contract AF-33(038)-23338. (WADC-TR-52-313(pt.2))

The brazing characteristics of Ti when joined to Ti, mild steel, and stainless steel were studied. Joints between these materials were induction brazed, torch brazed, and furnace brazed with commercial and experimental brazing alloys. Induction-brazed joints produced higher strengths than furnace- and torch-brazed joints. Joints in Ti were more easily brazed by all methods and using all alloys than those between Ti and mild and stainless steels. High-strength joints in Ti were obtained using Ti-base experimental brazing alloys, but ductility was poor. (auth)

1888

Battelle Memorial Inst.

CHEMICAL SURFACE TREATMENT OF TITANIUM. FINAL REPORT. H. A. Pray, P. D. Miller, and Richard A. Jefferys. Oct. 30, 1953. 34p. Contract DA-33-019-ORD-215. (WAL-401/45-33)

The investigation of surface treatments for Ti has resulted in the development of two types of baths that produce adherent, continuous coatings on Ti and its alloys. The first type is represented by a 5% NaOH anodic bath and the second by the fluoride-phosphate and the fluoride-borate immersion baths. The coatings minimize greatly the severe galling tendency of Ti. Extensive laboratory tests have shown that they are useful in wire or tube drawing. By comparison with present commercial methods for drawing Ti, such coatings show important possibilities in the future fabrication and use of the metal. It was found that certain treatments produced coatings that provided good service for various types of reciprocating and rotary wear. Samples ran continuously for over a month in reciprocating wear at 2500 psi and for several hundred hours in more severe rotary wear. These treatments involved coating the Ti in an immersion bath to produce an adherent, continuous crystalline coating, followed by a heat treatment in air at about 800°F for 3 hr or by application of a MoS_2 -Epon resin mixture. It is felt that these processes are of considerable potential usefulness because wear resistance can be produced at temperatures below those at which any phase transformation of the metal can occur. The wear resistance is comparable to that for carbonized or nitrided surfaces which require high-temperature

treatments, resulting in damage to the core properties. Paint-adhesion tests have shown value for the surface conversion coatings in paint applications on Ti articles. (auth)

1889

Bureau of Mines, College Park, Md.

EFFECT OF ATMOSPHERIC CONTAMINANTS ON ARC WELDS IN TITANIUM. INTERIM TECHNICAL REPORT COVERING PERIOD JANUARY 1 TO JUNE 30, 1953. J. C. Barrett and I. R. Lane, Jr. 34p. (WAL-401/155-7)

Within a steel chamber capable of being filled with a desired atmosphere, arc welds in Ti were made and their properties evaluated as a function of composition of the welding atmosphere. Tensile, bend, hardness, and impact tests were used to determine the differences in atmospheres. Oxygen, N, and dry air prove deleterious to weld ductility in contents as low as 0.25% of the He atmosphere. Small amounts of H and moisture, on the other hand, have little effect on weld properties, even when the sensitive impact test is used. (For preceding period see NP-4361.) (auth)

1890

CASTING OF MAGNESIUM BLOCKS WITH SPECIAL CONSIDERATION OF A NEW CORD CASTING PROCESS WITH IMMEDIATE COOLING OF THE LIQUID. P.

Menzen and W. Patterson-Rackwitz. Translated by H. A. Schmitt from *Aluminium* 25, 413-17(1943). 10p. (AEC-tr-1773)

The chill casting and crucible casting processes are compared with the cord casting process with immediate cooling of the liquid. The comparison includes metallurgical characteristics of the processes as well as their practical performance. (J.E.D.)

1891

CONTRIBUTION TO THE STUDY OF THE ELECTROLYTIC POLISHING OF ALUMINUM. J. Plateau, G. Wyon, A. Pillon, and C. Crussard. Translated by Yolande Faintino from *Métaux (Corrosion-Inds.)* 26, 235-49(1951). 31p. (AEC-tr-1786)

A study was made of the electrolytic polishing of Al in a perchloric acid-acetic anhydride bath. The nature of the bath, the mechanism of the polishing, and the variation of voltage and intensity during operation are reported. (J.E.D.)

1892

RESISTANCE OF METALS TO PLASTIC DEFORMATION. Yu. I. Yagn and I. A. Chaplinskii [Chaplinsky]. Translated from *Doklady Akad. Nauk S.S.S.R.* 90, 1023-6(1953). 4p. (NSF-tr-176)

Commercial purity Fe, steel 25 (75% ferrite and 25% perlite), steel 30KhGSA (special tempering sorbite), and Al bronze (water-quenched) were tested for linear tension and compression, plain compression, biaxial even compression, and triaxial compression under two equal stresses and a third stress half as large. The curves for the theory of maximum shearing stress and those relating the intensity of the true stress to the intensity of the true deformation do not coincide. The magnitude of the spherical part of the tensor of stresses has an effect on the resistance to plastic deformation and follows the linear law. Except for Al bronze, the resistance to deformation increases with the increasing of the compressing average normal stress. As the spherical part of the tensor of stresses on the resistance of the material to plastic deformation follows the linear law for the cases studied, this effect can be taken into account with sufficient accuracy by adding the term $A \bar{\sigma}$ (A being a constant coefficient for the given material and $\bar{\sigma}$ being the effect of the spherical part) to the intensity of stresses $\bar{\sigma}_1$. (J.S.R.)

1893

EFFECT OF THE RATIO OF RUBBING SURFACE TO HARDNESS ON SLIPPING CONDITIONS OF MACHINE PARTS IN CONTACT. D. N. Garkunov and I. V. Kragelskii

[Kragelsky]. Translated from *Doklady Akad. Nauk S.S.S.R.* 91, 1085-8(1953). 4p. (NSF-tr-178)

Studies indicate that the reduction in frictional force and in the abrasion of the surfaces under large loads in the regions of friction depends not only on a correct choice of rubbing metals but also on their arrangement in the coupling. The best arrangement of metals appears in reversed couples when the softer surface with a smaller friction area slides on the harder surface. When metals are arranged in couples, the ratio between the magnitude of the rubbing surface and the hardness of the machine parts in contact must be taken into account. (auth)

1894

EFFECT OF WATER AND ALCOHOL ON THE GRINDING OF METALS. V. D. Kuznetsov and V. D. Taranenko. Translated from *Doklady Akad. Nauk S.S.S.R.* 92, 49-52(1953). 4p. (NSF-tr-181)

The results of the investigations on the effect of water and ethyl alcohol on the grinding of Al, Cu, and Zn indicate that alcohol does not affect the tensile strength and relative elongation of the metals. The effect of the two media on friction is discussed. (J.E.D.)

1895

ON THE CORRESPONDENCE BETWEEN RELAXATION AND RATE CHARACTERISTICS IN PLASTIC EXTENSION. L. I. Vasilev [Vasilyev]. Translated from *Doklady Akad. Nauk S.S.S.R.* 92, 301-2(1953). 2p. (NSF-tr-195)

Data are presented on the correlation between relaxation and rate characteristics of Sn, Al, Cu, Cu-Ni alloy, and Ni during plastic extension. The experimental setup is described. Results confirm previous conclusions that the rate of plastic deformation is closely related to the relaxation capacity of the metal under study in the given conditions. (C.H.)

1896

WORK-HARDENING IN STRETCHED AND TWISTED ALUMINIUM CRYSTALS. H. W. Paxton and A. H. Cottrell (Univ. of Birmingham, England). *Acta Met.* 2, 3-8(1954) Jan. (In English)

The effects of plastic twisting on the tensile deformation of Al crystals are examined. After such a twist the tensile stress needed to continue tensile straining is sharply increased and, in some cases, this is followed by a period of increased work hardening. These effects are most pronounced when the twisting is applied during the period of "easy glide" in crystals oriented for single slip in tension, but they also appear in crystals which undergo multiple slip and work harden more severely during tensile straining. An explanation of the results is proposed in terms of the difficulty which those dislocations producing the tensile strain have in cutting through intersecting dislocations introduced during the twisting. The observed magnitude of the stress increment following a plastic twist can be predicted reasonably well by means of a formula deduced from theory, and the results provide evidence in favor of the view that multiple slip is a cause of work hardening. (auth)

1897

OBSERVATIONS ON THE STRUCTURAL CHANGES ACCOMPANYING RECOVERY IN SUPER-PURITY ALUMINIUM. E. C. W. Perryman (Aluminium Labs. Ltd., Kingston, Canada). *Acta Met.* 2, 26-37(1954) Jan. (In English)

The structure of super-purity Al has been examined by metallographic and x-ray examination directly after cold rolling at room and liquid air temperatures and after annealing at temperatures in the range from room temperature to 375°C. Hardness and microhardness tests have also been carried out. A small amount of work has been done on a super-purity Al-1% Mg alloy. It is shown that there exists directly after cold working at room temperature a subgrain

structure, the subgrains of which become increasingly perfect on annealing. This increase in perfection of the subgrains is accompanied by a decrease in hardness and it is found that the percentage softening brought about by this recovery process is about 50 to 60% irrespective of the amount of cold work. Furthermore it is shown that recovery can proceed both before and at the same time as recrystallization. The subgrain size decreases with increasing cold reduction, decreasing annealing temperature, and with additions of Mg. It is concluded that during recovery, dislocations within the subgrains diffuse, those of opposite sign cancelling each other out and others diffusing into the subgrain boundary regions. It is shown that this residual strain energy in the subgrain boundaries is probably the driving force for the growth of recrystallization nuclei. (auth)

1898

MECHANICAL DEFORMATION OF ALUMINIUM BICRYSTALS. R. Clark and B. Chalmers (Univ. of Toronto, Canada). *Acta Met.* 2, 80-6(1954) Jan. (In English)

Al specimens composed of two symmetrically oriented crystals having a common $\langle 111 \rangle$ axis were subjected to a tensile test. It was observed that the yield stress and the rate of work hardening increased with the orientation difference between the crystals. In the initial stages of plastic deformation a linear stress-strain region was observed; the length of this region became shorter as the rate of work hardening (i.e., the orientation difference) increased. (auth)

1899

THE CRYSTALLOGRAPHY OF THE β - α TRANSFORMATION IN TITANIUM. A. J. Williams, R. W. Cahn (Univ. of Birmingham, England) and C. S. Barrett (Inst. for the Study of Metals, Chicago). *Acta Met.* 2, 117-28(1954) Jan. (In English)

The orientation relationships, habit plane, and surface contour associated with the martensitic transformation in iodide Ti were investigated. The transformation markings studied were those on the natural facets of the specimens, which had originally been single crystals of β phase. The orientation relationship was close to, but not quite identical with, the Burgers relationship: $(0001)\alpha \parallel \{110\}\beta$; $\{11\bar{2}0\}\alpha \parallel \{111\}\beta$; the deviations were $1/2$ to 1° . The habit plane was close to $\{8, 9, 12\}$; to an accuracy of 1° . The orientations associated with individual habit plane variants were analyzed and fitted into a consistent scheme which was close to that expected if the transformation mechanism proposed by Burgers operated. Each habit plane was 10° from the variant of $\{112\}$ predicted as shear plane by Burgers. Data on the surface contour showed that the direction of atom motion was close to the variant of $\langle 111 \rangle$ required by Burgers, though the magnitude of the surface tilt was smaller than predicted. The precise contour of individual plates, as revealed by multiple beam interferometry, showed that accommodation slip had occurred which would reduce the surface tilt. The results could not be satisfactorily interpreted on the basis of Frank's theory of the martensitic transformation, but they provide some support for Geisler's views. (auth)

1900

INFLUENCE OF OXYGEN, NITROGEN, AND CARBON ON THE PHASE RELATIONSHIPS OF THE Ti-Al SYSTEM. R. J. Van Thyne and H. D. Kessler (Armour Research Foundation, Chicago). *J. Metals* 6, 193-9(1954) Feb.

Phase diagrams of the Ti-rich portion of the ternary systems from 0 to 10 wt. % Al and 0 to 1 wt. % O, N, and C were determined. Micrographic analysis of annealed high-purity arc-melted alloys was the principal method of investigation and was supplemented by x-ray diffraction. (auth)

1901

TITANIUM-CHROMIUM-OXYGEN SYSTEM. Chih-Chung

Wang (Sylvania Electric Products, Inc., Ipswich, Mass.) and Nicholas J. Grant (Mass. Inst. of Tech., Cambridge). *J. Metals* 6, 200-6(1954) Feb.

The Ti-Cr-O ternary system has been studied in detail near the Ti-rich corner within the limits of 10 wt. % O₂ and 20 wt. % Cr. Studies were extended, but not in detail, to the region beyond 25 wt. % O₂ (50 at. %) and 62 wt. % Cr (60 at. %). Four isothermal sections at 1400, 1200, 1000, and 800°C are presented, as well as two vertical sections at 1 and 2 wt. % O₂. (auth)

1902

AGING CHARACTERISTICS OF NICKEL-CHROMIUM ALLOYS HARDENED WITH TITANIUM AND ALUMINUM.

Rolf Nordheim and Nicholas J. Grant (Mass. Inst. of Tech., Cambridge). *J. Metals* 6, 211-18(1954) Feb.

An extensive study was made of the aging characteristics of alloys based on the 80% Ni-20% Cr composition hardened with Al and/or Ti, each up to 4%. Aging was followed by means of hardness and hot electrical resistance measurements as well as by x-ray and microscopy. Stress-rupture tests at 1500°F were utilized as a check on the predicted behavior. (auth)

1903

A CURSORY INVESTIGATION OF INTERMEDIATE PHASES IN THE SYSTEMS Ti-Zn, Ti-Hg, Zr-Zn, Zr-Cd, AND Zr-Hg BY X-RAY POWDER DIFFRACTION METHODS. Paul Pietrokowsky (California Inst. of Tech., Pasadena). *J. Metals* 6, 219-26(1954) Feb.

Intermediate phases in the binary metal alloy systems Ti-Zn, Ti-Hg, Zr-Zn, Zr-Cd, and Zr-Hg have been investigated by x-ray-powder-diffraction methods. Gamma Ti₃Hg and Zr₃Hg have a β -tungsten structure; TiHg and ZrHg are analogous to ordered AuCu (L₁ type); β Ti₃Hg and ZrH₃ are isomorphous with ordered AuCu₃ (L₁₂ type); ZrZn₂ is face-centered cubic (C 15 type); TiZn₂ crystallizes in a C 14 type structure; and Zr_(1-x)Cd_(x) occurs in cubic and tetragonal modifications in which a random distribution of atoms exists. Additional information for the intermediate phase TiZn₃ is presented. (auth)

1904

SYSTEM TITANIUM-MANGANESE-MOLYBDENUM. R. P. Elliott, W. Rostoker (Armour Research Foundation, Chicago) and B. W. Levinger (Tung-Sol Electric Inc., Bloomfield, N. J.). *J. Metals* 6, 228-32(1954) Feb.

Phase equilibria in the Ti-Mn-Mo system have been investigated in the composition range 100 to 60% Ti and in the temperature range 550 to 1150°C. Three out of ten isothermal sections are presented, as well as seven vertical sections, projections of the β space, and the surface of incipient melting. (auth)

1905

EFFECT OF IRON ON HARDNESS, BEND PROPERTIES AND WELDING OF TITANIUM SHEET. W. J. Barth, and A. L. Feild, Jr., (E. I. Du Pont de Nemours and Co., Newport, Del.). *Metal Progr.* 64, 74-7(1953) Nov.

Results indicate that 0.5% Fe has little effect on the room-temperature mechanical properties of commercial-purity α -Ti alloys in the range 55,000 to 70,000-psi yield strength. The addition of 1% Fe had a pronounced strengthening effect, although sheet and weld bend quality remained satisfactory. Aging studies on commercial-purity alloys containing 0.5% Fe showed stability, as-welded, at temperatures ranging up to 400°C. (J.E.D.)

1906

PREPARATION OF THIN LAYERS ON A TANTALUM SUPPORT. RELATIVE TECHNIQUE FOR OBTAINING VERY ADHERENT THERMAL DEPOSITS AND FOR FIXING TANTALUM ON COPPER. P. Garin, P. Léger, and P. Prugne (Centre d'Études nucléaires, Saclay, France). *J.*

phys. radium, phys. appl. 15, 45A-6A(1954) Jan. (In French)

In the Van de Graaff experiments, the target is deposited on a sheet of Ta sufficiently thick to absorb completely the radiation. The resultant heat is dissipated by a plate of Cu (cooled by water circulation) with which the sheet of Ta is in intimate thermal contact. The method used for covering the sheets of Ta with certain common metals such as Fe or Cu consists of the thermal evaporation of Fe or Cu on Ta heated to a high temperature. A Cu block is then pressed firmly against the Ta. (J.S.R.)

TRACER APPLICATIONS

1907

STUDY OF A DEFORMED STATE BY RADIOACTIVE ISOTOPES. S. I. Gubkin and S. A. Dovnar. Translated from *Doklady Akad. Nauk S.S.S.R.* 91, 1089-90(1953). 2p. (NSF-tr-145)

It is shown that the deformed state under plastic deformation can be studied by the method of coördinate network prepared by means of radioactive isotopes. (J.E.D.)

PHYSICS

1908

Los Alamos Scientific Lab. APPEARANCE POTENTIAL STUDIES. 1. DETERMINATION OF EXCESS KINETIC ENERGY. Richard J. Kandel. [1953?] 14p. Contract W-7405-eng-36. (AECU-2803)

The metastable ion suppressor on the Consolidated Engineering Corp. Model 21-103 mass spectrometer has been used as a retarding-potential device to determine the excess kinetic energies possessed by the ions formed during appearance potential measurements. The suppressor setting at which an ion beam is extinguished is compared with the extinction setting for an ion beam with no excess energy. These settings are studied as a function of ionizing voltage, extrapolated back to the appearance potential, and converted into units of energy. N⁺ from N₂ was found to have no excess kinetic energy at the appearance potential. CH₃⁺ from C₂H₆, CH₃⁺ from C₃H₈, CN⁺ from C₂N₂, and CH₃⁺ from C₆H₅CH₃ were all formed with excess kinetic energy. The following quantities were deduced after taking the excess energy into account: D(CH₃-CH₃) = 3.87 v; D(CH₃-C₂H₆) = 3.70 v; I(CN) = 15.13 v; I(C₆H₅) = 9.90 v; D(C₆H₅-CH₃) = 3.80 v; and D(C₆H₅-H) = 4.64 v. (auth)

1909

Metals Research Lab., Carnegie Inst. of Tech. ELECTRICAL CONDUCTION IN MOLTEN COPPER-IRON SULFIDE MATTES. G. M. Pound, G. Derge, and G. Osuch. [1953] 18p. Contract AT-(30-1)-1024. (NYO-6487)

Using a new alternating current potentiometer circuit and a specially designed four-terminal cell, the specific conductance of molten Cu₂S-FeS mattes was measured as a function of temperature over the complete range of composition from the liquidus to 1500°C. The high conductivities, about 1500 mho/cm for FeS and 100 mho/cm for Cu₂S, indicate that the conduction is electronic rather than ionic. Molten FeS has a negative temperature coefficient of specific conductance, resembling metallic conduction. Molten Cu₂S has a positive temperature coefficient, resembling semi-conduction. The binary roughly follows an additive rule of mixtures with respect to both magnitude and temperature coefficient of specific conductance. Pseudo-

metallic bonding in the liquid is postulated to explain these phenomena. (auth)

1910

Oak Ridge National Lab.

PHYSICS DIVISION SEMIANNUAL PROGRESS REPORT FOR PERIOD ENDING SEPTEMBER 10, 1953. Issued Dec. 17, 1953. 80p. Contract W-7405-eng-26. (ORNL-1620)

High-Voltage Physics. The neutron yields just above thresholds for ten (p,n) reactions have been investigated. The data, which give the (p,n) threshold energies for the reactions studied, have been fitted with a theory similar to the theory of inelastic neutron scattering. Differential elastic scattering cross sections for neutrons have been measured for Li, Be, B, and C at and in between all resonances below 1.5-Mev energy. The cross section for the reaction $\text{Li}^7(\text{d,t})\text{Li}^6$ from the threshold to the maximum energy of the 2.5-Mev Van de Graaff has been measured by counting the T produced by bombardment of Li^7 with deuterons. A reaction chamber containing proportional gas counters has been used to investigate the angular distribution of α particles from the $\text{Na}^{23}(\text{p},\alpha)\text{Ne}^{20}$ reaction. **Radioactivity and Nuclear Isomerism.** Angular correlation measurements of high precision have been carried out on Co^{60} - Ni^{60} , Ru^{106} - Rh^{106} - Pd^{106} , Hf^{181} - Ta^{181} , Bi^{207} - $\text{Pb}^{207}(\gamma,\gamma)$, and Bi^{207} - Pb^{207} (conversion electron- γ), and in some cases conversion coefficients have also been determined. The spectrum and half life (0.84 sec) of the Pb daughter of Bi^{207} have been studied by a resin-column separation technique. The γ -ray spectrum accompanying the fission of U^{235} , measured within 0.4 μsec , shows a smooth decrease from 0.5 to 7 Mev with no evidence of line structure. The attenuation of monoenergetic γ rays of 0.661, 1.51, and 2.76 Mev has been studied in Al, Pb, and H_2O by means of the scintillation spectrometer. Gamma rays accompanying the bombardment of Be and B by Po α particles have been studied by means of a three-crystal scintillation spectrometer. **Neutron Diffraction.** Further studies of the magnetic-scattering properties of Er metal at low temperatures show two magnetic phases, but the character of the higher-temperature phase is not fully understood. Magnetic disorder scattering in Fe-Cr and Co-Cr alloys has been used to determine the moments of the individual ions in these lattices. **Low Temperatures and Nuclear Polarization.** A brief résumé of the nuclear polarization experiment with Mn^{55} is given, and a new experiment on the interaction of polarized neutrons with polarized Sm^{149} nuclei is discussed. Susceptibility studies have been made on MnCl_2 and UCl_3 , which have antiferromagnetic transitions in the liquid-H temperature region. Some thermodynamic properties of Mn ammonium sulfate are discussed. **Heavy-Ion Physics.** A description is given of the present measurements of the electron capture and loss cross sections for heavy ions passing through gases. Representative results are given for He^+ and H^+ ions. **Neutron Cross Sections.** A new pile oscillator measurement of the thermal capture cross section of Th has been made, and time-of-flight spectrometer measurements are reported for Th, Ni^{62} , and Tc^{99} . **Instrumentation.** Development of a linear amplifier to replace the type A-1 has reached a late stage; the model has a rise time of 0.2 μsec and good performance with signals that are 50 times overload. The development of units for the low-cost analyzer is discussed. A Tl activated NaI crystal has been made to give good resolution, and its use as a self-coincident detector has already been shown to be very helpful in decay-scheme determinations (Mg^{28}). A proton-recoil counter with known neutron efficiency and with energy resolution of about 7% for 5-Mev neutrons has been tested. **Physics of Reactors.** A new measurement of the energy released per fission is given. A preliminary meas-

urement of the visible light given off in ionized air is also reported. **Theoretical Physics.** A consistent reduction of the nuclear operators in the theory of β decay to nonrelativistic form is presented. Particular consideration is given to the implications of this reduction relative to the pseudoscalar interaction in β decay and the interpretation of the Bi^{210} experimental data. Work on the magnetic scattering of slow neutrons by unquenched orbital moments is outlined. Brief statements are given of work centering around the calculation of angular distributions of products of nuclear reactions. (auth)

1911

Physical Metallurgy Labs., Columbia Univ. School of Mines
DIFFUSION OF HYDROGEN, NITROGEN, AND OXYGEN IN TITANIUM. SUMMARY REPORT. July 13, 1953. 80p. Contract DA-30-069-ORD-644. (WAL-401/149-11A)

The diffusion rates of H, N, and O in Ti metal were investigated, and their temperature dependence and activation energies were determined for all these elements in the β and H also in the α titanium structures. The diffusion coefficients determined appear to be substantially independent of the solute concentration, except possibly within limited ranges of concentration extremes. A mathematical analysis was carried out to account for the initial deviation from the parabolic rate law in gas-metal reactions. An approximately linear reaction rate was derived for short reaction times. The case of diffusion with a simultaneous formation and growth of a thin surface layer was also analyzed, and an expression was derived permitting approximate calculation of the solute diffusion coefficient in the surface layer from obtainable experimental data. This analysis was used to evaluate the diffusion coefficient of N in α titanium and TiN between 900 and 1570°C. A simplified method for the vacuum fusion analysis of H in high-purity Ti was developed which requires no bath additions and which permits lower temperatures than in the customary methods. (auth)

1912

INSTANTANEOUS PHOTOGRAPHY. (Mgnovennaya Fotografiya). L. I. Translated from *Uspekhi Fiz. Nauk* 44, 618-22(1951). 5p. (AEC-tr-1374; ATI-146526)

An electron-optical transformer is described which may be used as an inertialess shutter as replacement for shutters of the Kerr type for speed photography. The shutter was used for photographing with an exposure time of 0.5×10^{-8} sec. The time of exposure can be reduced to 10^{-8} sec. A setup is described with which the shutter could be adapted for purposes of stroboscopy. Data are presented on the resolving power of the device and on its use in the study of Pb azide explosions. It is suggested that the device may also be used for the study of spark discharges, shock waves, flight of rockets and projectiles, and for the study of objects subjected to x irradiation. (C.H.)

1913

PROPERTIES OF THE SUPERCONDUCTING MODIFICATION OF BISMUTH. N. V. Zavaritskii [Zavaritsky]. Translated from *Doklady Akad. Nauk S.S.S.R.* 91, 787-90 (1953). 4p. (NSF-tr-172)

Bi, condensed from the vapor onto surfaces cooled to the temperature of liquid He, is superconductive. At approximately 10 to 11°K there is a transition to the usual non-superconducting modification. In its superconducting form, Bi has a critical temperature of 6°K. In a magnetic field it behaves like a superconductor of the second group and is characterized by the value $H_{cb}0(T) = 1.45 \pm 0.7$ gauss cm deg. (J.S.R.)

1914

KINETICS OF LUMINESCENCE OF SILVER HALIDE SALTS. V. A. Arkangelskaya and P. P. Feofilov. Translated from *Doklady Akad. Nauk S.S.S.R.* 91, 1055-8(1953). 4p. (NSF-tr-173)

The kinetics of luminescence of pure salts of AgCl, AgBr, and AgI were studied in various states (as single crystals obtained from the melt, powders obtained by precipitation from solution, melts of those powders, emulsion layers, and layers sublimated *in vacuo*) by the "taumeter" method. In AgCl and AgBr the processes of buildup and decay occurred mainly in the interval between 10^{-6} and 10^{-3} sec. The buildup-decay curve was not symmetrical and, in general, nonexponential. It is dependent on the intensity of the exciting light. The results show the recombinational nature of the mechanism of luminescence of Ag halide salts. Some buildup-decay curves are given. (J.S.R.)

- 1915
THE MAGNITUDE OF THE OPTICAL ANISOTROPY OF THE BENZENE AND CARBON DISULFIDE MOLECULES AS DETERMINED BY LIGHT SCATTERING IN SOLUTIONS. M. F. Vuks and V. I. Elfimov [Yelfimov]. Translated from *Doklady Akad. Nauk S.S.S.R.* **92**, 29-32(1953). 4p. (NSF-tr-175)

The intensity of the anisotropy of the Rayleigh scattering of light in dilute solutions is determined, in suitable choice of solvent, by the anisotropy of the isolated molecules of the solute and the effective anisotropy in the liquid state of the molecules of the solvent and can be calculated by a formula analogous to that for gases. The measurement of the intensity of the anisotropic part of the Rayleigh scattering of solutions permits the determination of the optical anisotropy of the molecules of the dissolved substance. This constitutes a new method for the determination of the optical anisotropy of molecules. The experimental data confirm the assumption that the deviations of the intensity of anisotropy of light scattering in pure liquids from the quantities given by the formula derived for gases are due to the presence of short-range orientative order. (auth)

- 1916
THRESHOLD OF THE SECONDARY ELECTRON EMISSION OF NICKEL AND MOLYBDENUM. A. R. Shulman and E. [Ye.] I. Myakinin. Translated from *Doklady Akad. Nauk S.S.S.R.* **91**, 1075-8(1953). 4p. (NSF-tr-177)

The secondary electron emission of Ni and Mo for low velocities of primary electrons was investigated. The spherical-condenser method with the usual electrical circuit for this type of measurement was used. Special attention was devoted to the control of the focusing of the electron beam, which was done by measuring the current of the primary electrons to a target when the latter was moved in the direction of the beam and by observing the boundaries of the luminescent spot when the measuring target was replaced by a fluorescent target. A threshold of secondary emission was found to exist close to the work function of the metal, which indicated that, at least for small velocities of primary electrons, the secondary electrons come from the conducting region. (J.A.G.)

- 1917
SPIN-SPIN INTERACTION OF ELECTRONS AND THE IONIZATION ENERGY OF HELIUM. A. M. Sessler and H. M. Foley (Columbia Univ., New York). *Phys. Rev.* **92**, 1321(1953) Dec. 1.

It is suggested that discrepancies between theory and experiment on the ionization potential of He and He-like ions may be accounted for by the addition of spin-spin interaction terms, omitted in all previous calculations of the energy levels in He. Such a theory is developed for an interaction of two classical distributions of magnetic densities. (K.S.)

- 1918
THE RELATIVISTIC CORRECTION TO THE GROUND-STATE ENERGY OF HELIUM. A. M. Sessler and H. M. Foley (Columbia Univ., New York). *Phys. Rev.* **92**, 1321-2(1953) Dec. 1.

Three Hamiltonian terms are used to compute the relativistic corrections of the He ground-state ionization energy. It is shown that H_1 and H_2 , the one-electron operators, may be evaluated with sufficient accuracy by Hartree functions. H_3 is evaluated using the Hyleraas six-term function. The results for a hydrogenic function ($Z = 1.6875$) are given. Combining the interelectron magnetic interaction (see preceding abstract), the mass polarization term, the relativistic term, the Breit operator, and the Lamb shift, the value $-18.3 \pm 1 \text{ cm}^{-1}$ is obtained. (K.S.)

- 1919
A STUDY OF CHARGE EXCHANGE BY HELIUM IONS IN METALS. G. A. Dissanaikie (Cavendish Lab., Cambridge, England). *Phil. Mag.* (7) **44**, 1051-63(1953) Oct.

A study has been made of the equilibrium fractions of He^0 , He^+ , and He^{++} in a He beam traversing metallic foils of Be, Al, and Ag at energies from 0.13 to 1.1 Mev. The equilibrium fractions have been found to be independent of the metals used. The ratio σ_1/σ_c of the cross sections for electron loss and capture, respectively, by the He ions is proportional to v^m , where v is the ion velocity. In the exchange $\text{He}^0 \rightleftharpoons \text{He}^+$ the exponent m is equal to 3.08 ± 0.10 in the energy range 0.13 to 0.6 Mev studied. In the exchange $\text{He}^+ \rightleftharpoons \text{He}^{++}$ m appears to be constant at 5.10 ± 0.12 for energies between 0.43 and 1.1 Mev but decreases steadily with decreasing energy below this region. For the He^{++} ion, the speed for which $\sigma_1 = \sigma_c$ is found to be 2.55 times that of the orbital electron in the H atom and is almost exactly twice as great as the corresponding speed for the He^+ ion. (auth)

- 1920
THEORY OF DIFFUSION AND THERMODIFFUSION IN WEAK SOLUTIONS OF He^3 IN HELIUM II. V. N. Zharkov and I. M. Khalatnikov. *Doklady Akad. Nauk S.S.S.R.* **93**, 1007-9(1953) Dec. 21. (In Russian)

If, in He II free of He^3 impurities, a concentration and temperature gradient is formed, then diffusion and thermodiffusion impurities, associated with atoms of He^3 , will lead to an equilization of the concentration and temperature. The dependence of the coefficients of diffusion and thermodiffusion on the temperature and concentration are approximated. (J.S.R.)

- 1921
AN ELECTROMAGNET OF LARGE POTENTIAL FOR NUCLEAR PLATES. G. Sameda and M. Merlin (Univ. of Padua, Italy). *Nuovo cimento* (9) **11**, 73-81(1954) Jan. (In Italian)

An electromagnet has been studied with the aim of producing sufficiently high fields to permit direct and systematic measurements of magnetic deflection of particles in nuclear emulsions. For a power consumption of 800 kw, a field of 50,000 gauss has been attained in the disk-shaped volume between the pole pieces 3 cm in depth and 10 cm in diameter. (auth)

- 1922
MEASUREMENTS OF THE VISCOSITY OF He -GAS AT LIQUID TEMPERATURES AS A FUNCTION OF TEMPERATURE AND PRESSURE. A. Van Isterbeek, F. W. Schapink, G. J. Van den Berg, and H. J. M. Van Beek (Kamerlingh Onnes Lab., Leiden, Netherlands). *Physica* **19**, 1158-62(1953) Dec. (In English)

Measurements were carried out on the viscosity coefficient of He gas at liquid He temperatures as a function of temperature and pressure. Three different types of apparatus based on the oscillating-disk method have been used. The experimental values obtained for the viscosity coefficient as a function of temperature are approximately 10% too high as compared with the theoretical values calculated by De Boer (*Physica* **10**, 348(1943)). The rate of change in the viscosity as a function of pressure agrees

very well with the rate of variation found by Ubbink (*Physica* 13, 659(1947)) for the heat conductivity. (auth)

COSMIC RADIATION

1923

Duke Univ.

COSMIC RAY NUCLEAR INTERACTIONS IN GASES. W. W. Brown. Jan. 22, 1954. 16p. Contract N7onr-455, T. O. 3, Technical Report No. 5. (NP-5062)

The natural rates of occurrence, in the gases He, N, Ne, and A, of nuclear interactions of the cosmic-ray N-component, in which more than 8 Mev are given to charged secondary particles, have been measured. The rates/g-atom of the four gases are in about the same ratio as their geometric nuclear cross sections. An integrated flux of N-rays of $6.0 \times 10^{-3}/\text{cm}^2/\text{sec}$ would produce the observed rates of occurrence of nuclear interactions if the cross section were geometric. The rates in A, measured at sea level and 10,600-ft elevation, correspond to an absorption mean free path in air of $132 \pm 4 \text{ g/cm}^2$ for the total flux of N-rays. The interactions, 2783 in total, were observed in the gas of a cloud chamber filled to 5 atm. pressure. Inside the cloud chamber was placed a system of wires forming an ionization chamber. An expansion was initiated whenever a pulse from the ionization chamber corresponding to an energy release of more than 8 Mev (1.5 Po α) occurred. Fast reduction of the high voltage after electron collection was over permitted track formation on the positive ions. Of the nuclear interactions produced in A about 20% are produced by charged particles at the higher elevation and about 15% at sea level. (auth)

1924

DETERMINATION OF THE NUMBER OF SLOW π - AND μ -MESONS IN COSMIC RAYS AT VARIOUS ALTITUDES. Kh. P. Babayan, I. I. Zinger, and N. A. Marutyan. Translated from Doklady Akad. Nauk S.S.S.R. 92, 263-4(1953). 2p. (NSF-tr-184)

An abstract of this paper appears in *Nuclear Science Abstracts* as NSA 8-1130.

1925

THE EXISTENCE OF UNSTABLE CHARGED PARTICLES WITH MASS EXCEEDING THE MASS OF A PROTON. A. Alikhanyan, V. Kirillov-Ugryumov, N. Shostakovich, V. Fedorov, and G. Merzon. Translated from Doklady Akad. Nauk S.S.S.R. 92, 719-21(1953). 3p. (NSF-tr-204)

An abstract of this paper appears in *Nuclear Science Abstracts* as NSA 8-1600.

1926

COSMIC RAYS AT 60 M.W.E. UNDERGROUND. III. THE ANOMALOUS SCATTERING OF μ -MESONS. M. L. T. Kannangara (Univ. of Manchester, England) and G. S. Shrikantia (Imperial Coll., London, England). *Phil. Mag.* (7)44, 1091-1100(1953) Oct.

Large-angle scatterings which have been found on 126.6 m of the tracks of relativistic particles in Ilford G5 plates exposed at a depth of 60 m.w.e. underground are analyzed and are shown to be scatterings of μ mesons. A cross section of $(2.3 \pm 1) \times 10^{-28} \text{ cm}^2/\text{nucleon}$ is derived for scatterings greater than 7° by μ mesons with $p\beta > 100 \text{ Mev/c}$ in the cosmic radiation at 60 m.w.e., and a cross section of $(3.4 \pm 1.5) \times 10^{-27} \text{ cm}^2/\text{nucleon}$ for a similar scattering by μ mesons with $p\beta$ in the region (100 to 600) Mev/c. These cross sections are shown to be rather too high to be explained in terms of a pure Coulomb scattering at a finite nucleus. Agreement between theory and experiment can be achieved, however, on the assumption of a point-charge nucleus. Various mechanisms are examined for a possible explanation of the effect without success, and it is concluded that the scatterings probably represent a weak nuclear interaction of μ mesons. (auth)

1927

THE SPECTRUM OF THE PHOTON COMPONENT AT SEA LEVEL. C. Cernigoi (Univ. of Trieste) and G. Poiani (Istituto Nazionale di Fisica Nucleare, Padua, Italy). *Nuovo cimento* (9) 11, 41-8(1954) Jan. (In Italian)

The shape of the photonic spectrum of cosmic rays at sea level is obtained by measuring the absorption of the photon materialization products in an anticoincidence device and comparing with those observed using the shower theory under Rossi's "B" approximation. A good agreement is found if one takes a power spectrum with exponent 2.1. As the experimental device is particularly sensitive to low and medium energies, one can infer that this value is in agreement with modern views of the electrophotonic component in the air. It is suggested, however, that the spectrum exponent could not be the same in the whole energetic range, but rather variable as a function of the energy. (auth)

1928

AN ANALYSIS OF COSMIC RAY JETS. C. B. A. McCusker and F. C. Roesler (Dublin Inst. for Advanced Studies, Irish Free State). *Nuovo cimento* (9) 11, 98-9(1954) Jan. (In English)

The recent paper of Dilworth et al. (NSA 7-6106) in which they compared their results with those of the present writers (NSA 7-2153) applied the cylindrical tunnel theory to the low energy events. This theory is applicable only to the events with $\gamma_p \geq 500 \text{ Mev}$. (J.S.R.)

1929

THE IDENTIFICATION OF CHARGED COSMIC PARTICLES TERMINATING IN PHOTOGRAPHIC EMULSIONS SENSITIVE TO ELECTRONS. I. PARTICLES OF UNIT CHARGE. Georges Kayas (École Polytechnique, Paris, France). *J. phys. radium* 15, 34-8(1954) Jan. (In French)

Two methods for the identification of cosmic particles with unit charge ending their path in nuclear emulsions are studied: (a) counting of the pits and (b) counting of the δ rays. The two methods can be used to estimate the mass of the particles with a greater precision if the path available in the emulsion is long. The discussion of errors and corrections will be dealt with in the second part of this work. (tr-auth)

1930

SOME REMARKS ON THEORETICAL RESULTS OF EXTENSIVE AIR SHOWER MODELS. M. Bruin (Universiteit van Amsterdam, Netherlands). *Physica* 19, 909-14(1953) Oct. (In English)

Data obtained from recent theoretical models of extensive air showers are discussed. Also a comparison is made with experimental values. Although several of the theoretical values disagree with experiment, it appears possible to obtain consistency in most cases if small alterations are made. (auth)

1931

CLOUD CHAMBER STUDY OF NUCLEAR INTERACTIONS IN LEAD AND CARBON OF SECONDARIES EMITTED IN COSMIC RAY PENETRATING SHOWERS. Isao Kita and Osamu Minakawa (Kobe Univ., Japan). *Progr. Theoret. Phys. (Japan)* 10, 237-9(1953) Aug.

The following conclusions were drawn from an analysis of cloud chamber photographs, taken at 2,840 m, in a chamber containing 3 Pb plates and 4C plates, each 10 mm thick: (1) $56 \pm 7\%$ of the lightly ionizing secondaries were π mesons, and a majority of the remaining particles were protons; (2) the interaction mean free path for C was $70 \pm 16 \text{ g/cm}^2$; (3) the multiplicity spectrum of secondary showers in Pb was an exponentially decreasing function of increasing n , whereas a knee occurred in C at $n = 2$ or 3; (4) the integrated angular distributions of shower particles emitted by

secondary nuclear interactions were the same for C and Pb. (K.S.)

- 1932
THE ABSOLUTE INTENSITY OF COSMIC RAYS AT GEOMAGNETIC LATITUDE 25N. Yoshio Kitamura and Osamu Minakawa (Kobe Univ., Japan). *Progr. Theoret. Phys. (Japan)* 10, 239-41(1953) Aug.

Measurements of the intensities of the hard and soft cosmic-ray components at geomagnetic latitude 25°N are reported. A value of $(0.72 \pm 0.01) \times 10^{-2}/\text{cm}^2/\text{sec/sterad}$ was obtained for the hard component. (K.S.)

- 1933
ON THE ANGULAR DISTRIBUTIONS OF INTENSITY AND EAST-WEST ASYMMETRY OF THE COSMIC RAY NUCLEAR COMPONENT NEAR THE EQUATOR, STUDIED IN A SENSITIVE EMULSION. Tsai-Chü and Max Morand. *Compt. rend.* 237, 1517-19(1953). Dec. 9. (In French)

The angular zenithal distribution of the intensity of nucleons at the equator can be represented by $j(\theta) = J(0) \cos^{\lambda} \theta$, λ increasing with energy from 0.3 ± 0.1 to 2.1 ± 0.2 . The east-west asymmetry, concentrated between 30 and 45°, extends up to 260 Mev. (tr-auth)

CRYSTALLOGRAPHY AND CRYSTAL STRUCTURE

- 1934
CRYSTAL PLASTICITY. 3. THE MECHANISM OF THE SLIP PROCESS. E. Orowan. Translated by Margaret L. Schloo and Margaret V. Colven from *Z. Physik* 89, 634-59(1934). 22p. (AEC-tr-1770)

By suitable preparation of Zn crystals their expansion curves could be converted in an irregular way. With this it often happens that an expansion curve drawn after certain recovery, counter to the current ideas on solidifying and recovery, begins at higher stresses, or even proceeds throughout at higher stresses, than the highest stress of the previous expansion investigation. This phenomenon, in general like the irregular expansion, depends on difficulty in the formation of the first local slip. It resembles the difficulties in the formation of nuclei in phase transitions, since the appearance of the slightest slip causes a surgingly accelerated sliding. In one case the crystal could be charged for several minutes at 30% over its yield point without traces of persistent expansion. Conclusions are drawn, from this and from experimental material already known, on the origin and spread of the slip process as well as the ratio of the macroscopic sliding off to the physically homogeneous elementary slip processes. Finally, a summary of the new ideas on crystal plasticity is given. (auth)

- 1935
VIBRATIONAL SPECTRUM OF THE SIMPLEST MODEL OF AN ORDERING ALLOY. A. N. Men and A. N. Orlov. Translated from *Doklady Akad. Nauk S.S.S.R.* 90, 753-6(1953). 4p. (NSF-tr-160)

The theory of ordering alloys is briefly reviewed. Vibrations were calculated for a linear chain made of two types of atoms distributed over the nodes of the chain with an arbitrary degree of long-range order and with arbitrary relative concentration and which interact elastically. The application of data from a one-dimensional chain in explaining regularities typical of three-dimensional crystals is discussed. From the calculations presented, it is concluded that the maximum frequency of elastic vibrations decreases with ordering. (C.H.)

- 1936
PHOTOCHEMICAL TRANSFORMATION OF F-CENTERS IN KCl CRYSTALS AT HIGH TEMPERATURES. A. A. Shatalov. Translated from *Doklady Akad. Nauk S.S.S.R.* 92, 549-52(1953). 4p. (NSF-tr-198)

A study was made of the variation in the absorption of KCl

crystals containing F centers under the action of light at high temperatures to discover what states immediately followed the destruction or the coalescence of F centers as intermediate formations. (J.E.D.)

- 1937
POLARIZED LUMINESCENCE OF F-CENTERS IN CaF_2 . P. P. Feofilov. Translated from *Doklady Akad. Nauk S.S.S.R.* 92, 545-8(1953). 4p. (NSF-tr-203)

Luminescence occurred in CaF_2 crystals colored by additive methods (heating in vapors of Ca, Mg, Li, and other metals and electrolysis of heated crystals) as well as by subtractive methods (x raying, exposure to α , β , and γ rays, and exposure to ultraviolet rays). The excitation spectrum of the luminescence coincides with the absorption spectrum of the F centers and may be attributed to these centers, which may be considered as electrons localized in the vacant sites of halogen ions. (J.E.D.)

- 1938
METALLOGRAPHIC STRUCTURES IN COMMERCIAL TITANIUM. Roman Osadchuk (Univ. of Cincinnati, Ohio), William P. Koster and John F. Kahles. *Metal. Progr.* 64, 93-6(1953) Nov.

A brief study was made on the identification of several phases appearing in Ti alloys by heat tinting and electrolytic etching. (J.E.D.)

ELECTRICAL DISCHARGE

- 1939
ON THE THEORY OF STRIAE IN GASEOUS DISCHARGE. M. F. Shirokov. Translated from *Doklady Akad. Nauk S.S.S.R.* 89, 837-40(1953). 5p. (NSF-tr-120)

The phenomenon of luminous bands called "striae," accompanied by the periodic distributions of density of the charged particles, potential, and other parameters, is observed in the positive column of the electric discharges in gases. The theories concerning this phenomenon are essentially based on approximate solutions of Boltzmann's kinetic equation in the form of an expansion of the distribution function f in some small parameter. Theoretical considerations involved in expansion of this parameter and solution of the kinetic equations are discussed. (auth)

- 1940
USE OF A NARROW-BAND AMPLIFIER IN OSCILLOGRAPHIC INVESTIGATION OF THE ELECTRON VELOCITY DISTRIBUTION FUNCTIONS IN AN ELECTRICAL DISCHARGE. G. M. Malyshev and V. L. Fedorov. Translated from *Doklady Akad. Nauk S.S.S.R.* 92, 269-71(1953). 3p. (NSF-tr-186)

Methods of investigating the electron velocity distribution function of an electrical discharge through a gas are reviewed. A method is described which allows display, on the screen of an oscillograph, of the whole length of the curve of the second derivative of the probe current taken with respect to the probe potential. A simplified block diagram of the setup is included. Oscillograms are presented of second derivatives of the probe current with respect to the probe potential, which represent the electron velocity distribution functions. Accuracy of the method is discussed. (C.H.)

- 1941
SOME MEASUREMENTS ON A NOT SELF-SUSTAINING GAS DISCHARGE, WITH AN AXIAL MAGNETIC FIELD. J. Kistemaker and J. Snieder (Laboratorium voor Massaspectrografie, Amsterdam, Netherlands). *Physica* 19, 950-60(1953) Oct. (In English)

Valuable information has been gathered about the potential distribution inside the central arc column of a gas discharge with an axial magnetic field. Using a new type of hot probe technique, with differential probe currents,

very deep negative potential troughs in case of electro-negative gases (O_2 , Cl_2) were found. In the oscillating electron type of discharge, the troughs are much deeper than in case of a normal magnetic arc, e.g., 90 v with $V_{anode} - V_{cathode} = 100$ v. In general, the central plasma potentials for electropositive gases (A , H_2 , N_2) are still negative in comparison with the anode potential. This is in striking contrast with results of former investigations using the technique of probe characteristics, which usually lead to positive plasma potentials, relative to the anode cylinder (arc chamber). The depth of the potential trough as a function of the arc current, the pressure, and the concentration of various gas mixtures were investigated. (auth)

ELECTRONS

1942

CLASSICAL EXPLANATION OF THE ANOMALOUS MAGNETIC MOMENT OF THE ELECTRON. P. Caldirola (Univ. of Milan, Italy). *Nuovo cimento* (9) 11, 108-10(1954) Jan. (In Italian)

The classical electrodynamic motion equation for an electron proposed in a preceding article (NSA 8-1614) is discussed. It is shown that the solution of the equation is determined by assigning a value to two arbitrary constants and that the solution is not of the "non-physical" type. (J.S.R.)

1943

NON-RELATIVISTIC QUANTUM MECHANICS OF THE RIGID ELECTRON. Ludwig Waldmann (Max-Planck-Institut für Chemie, Mainz, Germany). *Z. Naturforsch.* a8, 583-93(1953) Oct. (In German)

In the Lorentz equation of motion of extensive rigid electrons or in the Bopp-Hönl field mechanics, higher time derivatives of the particle coordinates are caused by acceleration. By considering only the direct derivatives, the motion is conserved, and there exists a Lagrange function which makes possible Bopp's canonical quantization. For a physical interpretation it was assumed that the motion of the electrons approaches the usual Schrödinger theory. The acceleration is induced in the motion equation, and the electron is described by a scalar $\psi(r,t)$. In the expanded theory the fourth time derivatives in the motion equation were considered. To describe the electron a vector $\psi_K(r,t)$ and a symmetrical tensor step are needed as well as the scalar. These are united by a linear equation system. A correction is given for the H spectrum, which agrees with the experimental Lamb shift or the results of quantum electrodynamics if a suitable value of the frequency ω is chosen. The theory is non-relativistic, and only preliminary results are given for the value of ω or the electron radius. (tr-auth)

GASES

1944

Los Alamos Scientific Lab.

OBSERVATION OF TAYLOR INSTABILITY IN GASES. Russell E. Duff and Herbert T. Knight. [1954?] 10p. Contract [W-7405-Eng-36]. (AECU-2784)

A theoretical treatment was made of the instability of an interface between two gases when accelerated in a direction perpendicular to itself. Equations are given which summarize Taylor's results for the rate of growth of amplitude of an infinitesimal, two dimensional, sinusoidal disturbance on the surface. (J.E.D.)

1945

Callery Chemical Co.

METERING OF GASES INCLUDING DIBORANE. C. A. Thomas and D. K. Eads. Jan. 29, 1954. 42p. (CCC-1024-TR-4)

It has been definitely established that a critical orifice meter (one which operates at sonic velocity) may be calibrated with N_2 gas and then used for B_2H_6 . Theoretically, the B_2H_6 flow rates should be about 1 or 2% less than the N_2 flow rate for the same upstream orifice pressure, but it has been found that within experimental error, the calibrations are identical. Experiments with Fisher-Porter tri-flat flowmeters show that when B_2H_6 flow-rate curves are calculated according to the procedures recommended for such instruments, the resulting curves are well within the mechanical accuracy of the meters. It was found, however, that the calibrations engraved on the tubes of such meters are not entirely satisfactory and that they should be calibrated individually. The most useful form of calibration curve is a graph of the tube ratio of tube-to-float diameter vs. the float position. Such a calibration curve is applicable to any gas or liquid. (auth)

1946

Columbia Univ.

THE MEASUREMENT OF THE THERMAL CONDUCTIVITY OF GASES AT HIGH TEMPERATURE. ANALYSIS OF AN ALTERNATING PLUS DIRECT CURRENT HOT WIRE METHOD WHICH AVOIDS RADIATION ERROR. PROGRESS REPORT. Charles F. Bonilla, Barry L. Tarmy, and C. S. Lee. Jan. 20, 1954. 27p. Contract Nonr-266(11). (CU-1-54-Nonr-266(11)-Ch.E.)

A method is mathematically derived for the measurement of the thermal conductivity of gases which is independent of radiation and particularly suitable at elevated temperatures. The method employs a conventional hot-wire cell with its wire heated by a sinusoidal a-c superimposed upon a d-c. The operating conditions under which the radiation introduces no appreciable error are indicated, as well as the inherent limitations of the method. Optimum cell design and operating conditions are suggested. (auth)

INSTRUMENTS

*1947

Institute of Engineering Research, Univ. of Calif., Berkeley
ORIFICE METERING COEFFICIENTS FOR LEAD-BISMUTH EUTECTIC. H. A. Johnson, J. P. Hartnett, W. J. Clabaugh, and L. Fried. Dec. 1953. 33p. Contract AT-11-1-GEN-10, Project 5, Phase II. (AECU-2798)

Orifice coefficients are reported for four different size sharp-edged orifice plates calibrated with both water and Bi-Pb eutectic in a 1.5-in. pipe with flange taps. The resulting coefficients for the water and Bi-Pb are in agreement within the calculated accuracy of 3% for each of the four sizes when compared at a constant orifice Reynolds number; the values obtained in the 1.5-in. pipe are within 2% of those recommended by the ASME for a 2-in. standard pipe. (auth)

1948

SHARP-FOCUS X-RAY TUBES AND HIGH-INTENSITY MONOCHROMATORS. B. Ya. Pines. Translated from *Izvest. Akad. Nauk S.S.S.R., Ser. Fiz.* 16, 333-8(1952). 12p. (AEC-tr-1791)

General characteristics of sharp-focus x-ray tubes are reviewed, and the possibilities are discussed of using them in structural x-ray photography to increase the radiation intensity and resolving power during structural x-ray analysis. Problems associated with thermal conditions, sharp focus, optimum size of the focus, and obtaining a long, sharp linear focus for studying the structure of microcrystals are discussed. The need is expressed for the construction of a high-intensity monochromator which would give a sharp point secondary focus. (C.H.)

ISOTOPES

1949

Atomic Energy Research Establishment, Harwell, Berks (England)

THE HALF LIFE OF LONG-LIVED Kr^{85} . J. F. Turner. Sept. 3, 1953. 8p. (AERE-N/R-1254)

The use of a thin-lens β spectrometer with a scintillator detector as a high-stability counting equipment is described. A repetitive accuracy in a counting rate of 0.04% is achieved. Observation of the decay of Kr^{85} over a period of 6 months resulted in a half-life value of 10.57 ± 0.14 yr. (auth)

1950

MAGNETIZATION TIME OF A WEAK SOLUTION OF He^3 IN He^4 . A. Akhiezer [Akhiyezer] and V. Aleksin. Translated from *Doklady Akad. Nauk S.S.S.R.* 92, 259-62(1953). 4p. (NSF-tr-183)

The magnetization time of a weak solution of He^3 in He^4 as a function of the temperature and the concentration of He^3 is reported. (J.E.D.)

1951

SHORT-LIVED NEUTRON-DEFICIENT ISOTOPES OF RHODIUM AND PALLADIUM. A. H. W. Aten, Jr., and T. de Vries-Hamerling (Inst. voor Kernfysisch Onderzoek, Amsterdam, Netherlands). *Physica* 19, 1200 (1953) Dec. (In English)

If Ru is irradiated with 52-Mev He^{+2} ions, a Pd fraction with a short β^+ period can be isolated. A Rh fraction with period of 9 min can be obtained from the Pd. The β^+ energy for the Rh is 4.0 ± 0.5 Mev. The Pd isotope has a half life of 15 ± 3 min. The Pd isotope is probably Pd^{88} , and the Rh isotope, Rh^{90} , but an atomic weight of 96 is not impossible. (J.S.R.)

ISOTOPE SEPARATION

1952

Ames Lab.

RADIOACTIVE ISOTOPE SEPARATION BY NUCLEAR RECOIL. H. Morinaga and D. J. Zaffarano. [Jan. 5, 1954]. 2p. Contract W-7405-eng-82. (ISC-440)

A radioactive separation scheme is proposed for nuclear reactions of the (γ, n) , (d, p) , and $(\alpha, 2p)$ type, where product nuclides have the same atomic number as the initial nuclides. It is pointed out that for light nuclei, where the recoil product has a range which is small compared to the size of a colloiddally suspended donor, a high degree of concentration should be achieved in the suspending, or catcher, phase. Experimental verification has been achieved by using the $\text{C}^{12}(\gamma, n)\text{C}^{11}$ reaction in a colloidal graphite solution. It was found that the C bombarded as a colloid lost as much as 80% of its activity into the water phase. (K.S.)

MASS SPECTROGRAPHY

1953

Knolls Atomic Power Lab.

POSITIVE ION COUNTING FOR MASS SPECTROMETER BEAM CURRENTS OF 10^{-14} TO 10^{-18} AMPERE. F. A. White and T. L. Collins. Oct. 30, 1953. 25p. Contract W-31-109-Eng-52. (AECU-2792)

A reliable method for detecting and recording very small ion beam currents is described. A twenty-stage electron multiplier is used in conjunction with scalars and other circuitry for counting individual positive ions. Advantages and limitations of this method, as applied to mass spectrometer problems, are discussed. (auth)

MATHEMATICS

1954

Los Alamos Scientific Lab.

PROPERTIES OF THE HUGONIOT FUNCTION. R. D.

Cowan. [1953?] Decl. Aug. 25, 1953. 3p. Contract W-7405-eng-36. (AECD-3608)

1955

Brookhaven National Lab.

A TABLE OF THE INTEGRAL

$$\Psi(x, t) = \frac{1}{2\sqrt{\pi t}} \int_{-\infty}^{\infty} \frac{\exp\left(-\frac{(x-y)^2}{4t}\right)}{1+y^2} dy$$

M. E. Rose, W. Miranker, and P. Leak, Computing Facility, AEC, Institute of Mathematical Sciences, New York Univ., and G. Rabinowitz and V. L. Sailor, Brookhaven National Lab. 10p. Sept. 1953. (BNL-257)

Values of $\Psi(x, t)$ are tabulated for a range of x between 0 and 10 and a range of t between 0.025 and 100. (K.S.)

1956

Oak Ridge National Lab.

REVISED Z TABLES OF THE RACAH COEFFICIENTS.

L. C. Biedenharn and A. Simon. Feb. 16, 1954. 9p. Contract W-7405-eng-26. (ORNL-1501(suppl.1))

The function $Z(l_1 J_1 l_2 J_2; 0 L)$ is tabulated for values of L in the range 0 to 8. (J.A.G.)

1957

A STOCHASTIC PROBLEM RELATING TO COUNTERS.

Alladi Ramakrishnan and P. M. Mathews (Univ. of Madras, India). *Phil. Mag.* (7)44, 1122-8(1953) Oct.

The probability distribution function $\pi(n, t)$ of the number of registered events n in a time interval t for a counter in the case when the registered and unregistered events are followed by different dead times is derived by using the method of product densities formulated recently. (auth)

1958

FURTHER REMARKS ON TAMM-DANCOFF METHOD.

G. Morpurgo (Univ. of Rome, Italy). *Nuovo cimento* (9) 11, 103-5(1954) Jan. (In English) (cf. NSA 8-1763)

The second Tamm-Dancoff order was renormalized in order to exhibit the difficulties of the method. In order to renormalize in the second order a Lévy-Klein expansion in a series of g must be used. The method is usually unreliable for precise calculations (although it can give some qualitative insight). (J.S.R.)

MEASURING INSTRUMENTS AND TECHNIQUES

1959

Atomic Energy Research Establishment, Harwell, Berks (England)

SUMMARY OF ATOMIC ENERGY RESEARCH ESTABLISHMENT (HARWELL) EQUIPMENT FOR USE IN PROSPECTING AND ASSAYING RADIOACTIVE ORES. Oct. 30, 1953. 13p. (AERE-EL/M-83)

Portable Geiger counter ratemeters of medium sensitivity for detecting γ rays, portable ratemeters providing comprehensive facilities for prospecting, assaying, activity mapping, and mining control or survey, borehole-logging equipment, transportable (car or airborne) radioactivity detecting equipment, and laboratory assay equipment are described. (J.E.D.)

1960

Atomic Energy Research Establishment, Harwell, Berks (England)

THE MEASUREMENT OF GAMMA-RADIATION FROM THE HUMAN BODY. D. Taylor, J. Rundo, P. G. Jensen, O. M. Henriques, and F. Wade. Sept. 22, 1953. 17p. (AERE-EL/R-1250)

The apparatus described consists of a series of ionization chambers which surround a stretcher on which the patient is placed during measurement of γ radiation from the body. Design considerations and possible modifications are discussed, and data on sensitivity are presented. Data are tabulated from measurements on a number of

persons with no known occupational exposure to long-lived γ -emitting material. (C.H.)

1961

Brookhaven National Lab.

ESCAPE PEAK CORRECTION TO GAMMA-RAY INTENSITY MEASUREMENTS MADE WITH SODIUM IODIDE CRYSTALS. Peter Axel. Sept. 1953. 15p. (BNL-271)

A correction is described which is important in the determination of intensities of low energy γ rays when a NaI scintillation detector is used. The correction simplifies accurate intensity measurements by taking into account a major distortion of the scintillation spectrometer pulse height distribution caused by the diffraction of x rays within the crystal. An appendix contains a justification for treating the crystal as infinitely thick and neglecting the Compton effect. (C.H.)

1962

STUDY OF SCINTILLATION FROM ALKALI HALIDES. J. Bonanomi and J. Rossel. Translated from *Helv. Phys. Acta* 24, 310-14(1951). 6p. (AEC-tr-1776)

An abstract of this paper appears in *Nuclear Science Abstracts* as NSA 6-302. (J.S.R.)

1963

THE MAGNETIC MASS-SPECTROMETER IN COMBINATION WITH A WILSON CLOUD CHAMBER. A. Alikhanyan, V. Kirillov-Ugryumov, N. Shostakovich, and V. Fedorov. Translated from *Doklady Akad. Nauk S.S.S.R.* 92, 255-7 (1953). 4p. (NSF-tr-182)

The magnetic mass spectrometer has been used a great deal in recent years for the investigation of cosmic radiation. A detailed description is given of a system consisting of a magnetic spectrometer and a large Wilson cloud chamber placed outside the magnetic field and containing a series of Cu plates. The system is capable of recording efficiently particles whose lifetime is longer than 5×10^{-8} sec as a particle traveling with a velocity c passes through the system in that time. Examples are given of mass measurements and precision. (J.S.R.)

1964

PREPARATION OF FISH TISSUES FOR GROSS BETA RADIOASSAY. Louis A. Krumholz and A. H. Emmons (Oak Ridge National Lab., Tennessee). *J. Wildlife Management* 17, 456-9(1953) Oct.

A wet digestion technique is described which has proved satisfactory for the routine preparation of fish tissues for the determination of gross β radioactivity. The method is particularly suited to samples of tissues containing non-volatile, long-lived radioactive fission products, and eliminates most of the tedious weighing procedures that accompany routine radioassay. (C.H.)

1965

USE OF A SCINTILLATION SPECTROMETER IN RADIO-CHEMICAL ANALYSIS. B. Kahn and W. S. Lyon (Oak Ridge National Lab., Tennessee). *Nucleonics* 11, No. 11, 61-3 (1953) Nov.

A gamma scintillation spectrometer is described which may be used to identify radioisotopes by the energy and relative intensity of the γ rays they emit. Calibration of the spectrometer for use in radiochemical analysis is discussed, and applications of the instrument are suggested. (C.H.)

1966

PENETRATION OF X- AND GAMMA RAYS TO EXTREMELY GREAT DEPTHS. U. Fano (National Bureau of Standards, Washington, D. C.). *J. Research Nat'l. Bur. Standards* 51, 95-122(1953) Aug.

Earlier work on the asymptotic trend of the x-ray intensity at great distances from a source is reviewed and completed in various aspects. The asymptotic law is shown to be the same as in the "straight-ahead" approxi-

mation (which disregards deflections) whether the primary energy is higher or lower than the energy of minimum absorption, provided a constant is replaced by the eigenvalue of a suitable Wick equation. The penetration in directions oblique to the source direction hardly ever attains its asymptotic trend when the source energy is lower than the energy of minimum absorption. This situation raises a difficult problem regarding the penetration law in the range of great depths where the asymptotic trend is being approached very slowly. (auth)

1967

THE DOSIMETRY OF BETA RADIATIONS. Robert Loevinger (Mt. Sinai Hospital, New York). *Radiology* 62, 74-82(1954) Jan.

The dosimetry of β radiation from small sources is shown to depend upon knowledge of the distribution of absorbed energy around a point source of β particles. The difficulty of making a direct determination of this quantity is discussed. Equations are given for determining this point source energy distribution function from measurements on very thin plane β sources. The results of such measurements on six β emitting isotopes are given in the form of a two-part equation. Comparison of this theoretical result with the experimental points is shown in the form of graphs. The theory represents the measurements closely, from very small distances out to the end of the β range. (auth)

1968

RECOMMENDATIONS OF THE INTERNATIONAL COMMISSION ON RADIOLOGICAL UNITS. *Radiology* 62, 106-9 (1954) Jan.

Recommendations of the International Commission on Radiological Units, as revised at the Seventh International Congress of Radiology, Copenhagen, July 1953, are presented. (C.H.)

1969

CONSTANCY OF PHOTOMULTIPLIER GAIN. R. Wilson (Clarendon Lab., Oxford, England). *J. Sci. Instr.* 30, 472-4 (1953) Dec.

Some of the factors in a photomultiplier circuit which influence the gain are discussed, and it is shown how variations in the gain from causes external to the photomultiplier tube may be minimized. (auth)

1970

AN EFFICIENT GEIGER COUNTER FOR USE WITH MOLYBDENUM K_{α} X RAYS. G. K. Williamson and R. E. Smallman (Univ. of Birmingham, England). *J. Sci. Instr.* 30, 486(1953) Dec.

The construction of an end-window Geiger-Mueller tube is described. The tube has been made sensitive to the K_{α} radiation of Mo by using a 0.008- to 0.010-in.-thick microscope cover glass for the end window. High-stability performance is reported. (K.S.)

1971

A SMALL ADJUSTABLE X-RAY CRYSTAL MONOCHROMATOR. J. Fortey and E. Cohen (Pilkington Bros. Ltd., St. Helens, Lancs., England). *J. Sci. Instr.* 31, 11-13(1954) Jan.

Quantitative measurements of x-ray scattering patterns from glassy substances are much facilitated by using crystal-reflected monochromatic radiation in place of the normally used mixture of continuous and characteristic radiations. A monochromator is described for which compactness and simplicity in operation are claimed. The crystal is provided with the necessary degrees of freedom and the adjustment effected with the requisite accuracy. Parasitic and "white" radiations are suppressed and the strongest component of a multiply reflected beam and be easily selected. The instrument is not suitable for use with elastically bent focusing crystals. (auth)

1972

A VIBRATING NEEDLE ELECTROMETER. Y. L. Yousef and R. Kamel (Univ. of Cairo, Giza, Egypt). *J. Sci. Instr.* **31**, 13-15(1954) Jan.

A dynamic type of mechanical electrometer, incorporating a simple electronic circuit, is described. The underlying principle is that the electrostatic force due to the charge under test is modulated by a small periodic component so that, instead of merely deflecting the suspended system, which in the present case is simply a metallic reed, it sets it also into resonant vibrations the amplitude of which is proportional to the charge, and may be easily measured directly on an output indicator. The electrometer can be used in a null arrangement in which the reed vibrations are prevented by an opposing voltage. The electrometer capacity is 3.9 pf, and the output indication per volt is 0.25 v readable to 0.005 v. A theory is given and the applications are discussed. (auth)

1973

APPLICATION OF THE WILKINSON THEORY TO GEIGER-MÜLLER COUNTERS WITH AN EXTERNAL CATHODE. Daniel Blanc and Henri Zyngier (Collège de France, Paris, France). *J. phys. radium. phys. appl.* **15**, 1A-4A(1954) Jan. (In French). (cf. NSA 7-6176).

The application of the Wilkinson formulas to counters with external graphitization allows the determination that a potential difference existing between the external and internal surfaces of the counter and the pulse charging are, in the first approximation, proportional to the overvoltage. The formulas obtained were verified at different temperatures; the resistance of the glass was deduced. The results obtained agreed with the classical measurements of resistance. (tr-auth)

1974

ESTIMATION OF THE FLUX OF THERMAL NEUTRONS BY NUCLEAR PHOTOGRAPHIC EMULSIONS IMPREGNATED WITH LITHIUM. Concèle Gimenez and Jacques Labeyrie (Centre d'Études nucléaires, Saclay, France). *J. phys. radium. phys. appl.* **15**, 38A-44A(1954) Jan. (In French)

The method described utilizes the reaction $\text{Li}^6(n, \alpha)\text{H}^3$. It permits, with Ilford photographic plates with Li 50 μ thick, the detection of the integrated flux between 10^6 and 5×10^8 neutrons/cm². The maximum time of integration is of the order of 3 months. This method is essentially designed for the surveillance of the flux received by personnel exposed to neutrons. The sensitive emulsions are carried for a week; after development the α -t trajectories are counted. The sensitivity is sufficient to detect $\frac{1}{200}$ of the weekly tolerance dose for thermal neutrons. This method presents two advantages over that which utilizes, for the determination of slow neutrons, the blackening of an emulsion by the secondary γ rays of Cd: it is much more sensitive and it necessitates fewer precautions in the stocking and development of emulsions. (tr-auth)

1975

COINCIDENCE TYPING RECORDER "OLIVETTI" WITH 22 CHANNELS. Domenico Garelli and Italo Federico Querica (Univ. of Rome, Italy). *Ricerca sci.* **22**, 276-84(1952) Feb. (In Italian).

An electronic mechanical system for recording multiple coincidence is described. The device involves a modified Olivetti tele-typewriter. (auth)

1976

SCINTILLATION COUNTING AND ITS MEDICAL APPLICATIONS. W. V. Mayneord (Royal Cancer Hospital, London, England). *Brit. J. Appl. Phys.* **4**, 353-8(1953) Dec.

The fundamental physics of scintillation counting is reviewed, and the advantages of applying scintillation counting techniques to medical problems are discussed. Techniques

and instruments are described for use in clinical investigations such as metabolic studies, external counting, scintillation dosimetry, and scanning, and results obtained are evaluated. (C.H.)

1977

RADIO-CARBON DATING BY A PROPORTIONAL COUNTER FILLED WITH CARBON DIOXIDE. Hl. De Vries and G. W. Barendsen (Rijks-Universiteit, Groningen, Netherlands). *Physica* **19**, 987-1003(1953) Oct. (In English)

A technique is described for the measurement of the natural activity of C^{14} in a CO_2 -filled proportional counter. The following experimental details are discussed: the characteristics of the counter, the influence of gas pressure on the working voltages and on the counting rates, the effect of electronegative impurities, the background, the chemical procedure, the countertubes, the electronic apparatus, and finally the possible sources of errors. The efficiency of the counter is 100% in the sensitive part. The counting rate due to fresh C is 5.6/min, whereas the background is 3.9/min. At present the counter contains CO_2 at three atm., but the measurements indicate that it will be possible to increase the pressure at least up to about 15 atm. Up to now 30 samples have been dated. (auth)

1978

DIFFERENTIAL DISCRIMINATOR OSCILLOGRAPH AND ITS APPLICATION TO A COINCIDENCE CIRCUIT. F. Demichelis and R. Malvano (Istituto di Fisica Sperimentale del Politecnico, Turin, Italy). *Nuovo cimento* (9) **11**, 49-52(1954) Jan. (In Italian)

A differential discriminator in which the pulses are conveniently displayed on the screen of a cathode ray oscilloscope, photographed, and explored with a microphotometer is described. The discriminator is used in connection with a coincidence apparatus. (auth)

MESONS

1979

Radiation Lab., Univ. of Calif., Berkeley
EXCITATION FUNCTION FOR POSITIVE PIONS PRODUCED AT 90° IN PROTON-CARBON COLLISIONS (thesis). Daniel Allen Hamlin. Nov. 20, 1953. 57p. Contract W-7405-eng-48. (UCRL-2414)

The differential cross section for positive pions produced at 90° in the reaction $p + \text{C} \rightarrow \pi^+$ was measured in the proton energy interval 235 to 336 Mev. Pions emitted at 90° from the target bombarded by the external proton beam of the Berkeley 184-in. synchrocyclotron were identified by the use of a scintillation counter telescope and delayed coincidence based on the $\pi^+ - \mu^+$ decay. The pion energy spectrum obtained at each proton energy was corrected and integrated to obtain the relative yields that are shown below (together with standard deviations due to statistics of counting).

Relative Yield at 90° for $p + \text{C} \rightarrow \pi^+$

T_{proton} (Mev)	235	264	294	313	336
Relative $\frac{d\sigma(T_p, 90^\circ)}{d\Omega_{\text{lab}}}$	14.7 ± 2.4	30.5 ± 3.4	43.9 ± 4.3	76.6 ± 3.0	100.0 ± 3.6

For the assumed power law $d\sigma/d\Omega \sim (T_p - T_0)^b$ the exponent (calculated by least squares) is 2.5 ± 0.6 ; T_0 was taken to be the absolute threshold (~ 150 Mev) for this reaction. Normalization to nuclear emulsion data sets the absolute scale at $T_p = 336$ Mev to be $d\sigma(336, 90^\circ)/d\Omega_{\text{lab}} = (3.20 \pm 0.16) \times 10^{-28}$ cm²/sterad. (auth)

1980

VELOCITY DISTRIBUTION OF THE PAIR COMPONENTS

IN π^0 DECAY. O. Halpern and K. Baumann (American Express Co., Zürich, Switzerland). *Phys. Rev.* **92**, 1070-1 (1953) Nov. 15.

The decay mode of a neutral π meson is considered to be a process involving the production of two photons, one of which creates a positron-electron pair. The difference in conservation rules for pair creation in this case is shown to account for the deviations commonly observed in the distribution of energy between the two components of the pair. (K.S.)

1981
ON THE ANALYSIS OF τ -MESON DATA AND THE NATURE OF THE τ -MESON. R. H. Dalitz (Univ. of Birmingham, England). *Phil. Mag.* (7) **44**, 1068-80 (1953) Oct.

A convenient method of representation is proposed for data on τ -meson decay configurations, applicable when the unlike outgoing π meson is not distinguished. The relation between the spin and parity of the τ meson and the distribution of decay configurations is obtained for some simple cases. The hypothesis that the τ and χ mesons are identical requires a nonzero spin for this particle, and the available data on τ -meson decay does not exclude this possibility. However, observations in which the unlike outgoing π meson is not distinguished are relatively ineffective in discriminating between the various possibilities. The distortions which strong meson-meson attraction may produce in τ -decay configurations are discussed; the present data offer no evidence on this effect. (auth)

1982
THE ANOMALOUS SCATTERING OF μ -MESONS IN LEAD. B. Leontic and A. W. Wolfendale (Univ. of Manchester, England). *Phil. Mag.* (7) **44**, 1101-12 (1953) Oct.

A multiplate cloud chamber has been operated at sea level under a thick Pb absorber, and the scattering of penetrating particles—presumably μ mesons—has been investigated. In common with the results of other workers, a component of scattering has been found which is not consistent with the distribution expected from simple Coulomb scattering from a nucleus in which the charge is distributed uniformly throughout the volume ('solid' nucleus). It is found that the magnitude of this anomalous component is similar to that expected from the Coulomb interaction with a nucleus of effective radius much smaller than that of the 'solid' nucleus. Since it is very unlikely that the electrostatic charge of the nucleus can be considered to be concentrated at the center of the nucleus, it is concluded that the anomaly is probably due to a short range nonelectric interaction between μ mesons and a nucleons. (auth)

1983
ON THE NATURE OF THE κ -MESON. N. Dallaporta (Univ. of Padua, Italy). *Nuovo cimento* (9) **11**, 82-7 (1954) Jan. (In English)

Assuming that the κ -meson is a fermion which interacts with other fermions through the universal Fermi interaction, the decay probability and the capture probability by nuclei are calculated. The obtained values are in rather good agreement with the experimental data till now available. (auth)

1984
ON THE PRODUCTION OF ELECTRONIC COMPONENT BY FAST μ -MESONS. A. Lovati, A. Mura, and C. Succi (Univ. of Milan, Italy). *Nuovo cimento* (9) **11**, 92-5 (1954) Jan. (In English)

For low-energy μ mesons the rate of production of δ rays in a cloud chamber was determined to be 3δ rays/g/cm² of A. For intermediate energies the rate of production of knock-on electrons in Pb was 6% forward and 0.5% backward in agreement with the results of other authors. The experimental data on the angular distribution

of knock-on electrons fit well with the empirical relationship of the form $\cos^n \theta$, with $n = 2.5$. The production of successive knock-on electrons in Pb is tabulated. For high energies, the probability of energy transfer greater than 1 Mev from μ mesons by electron production is tabulated. (J.S.R.)

1985
THE HALF LIFE OF THE τ MESON. E. Fabri and B. F. Touschek (Univ. of Rome, Italy). *Nuovo cimento* (9) **11**, 96-7 (1954) Jan. (In Italian)

The decay of the τ meson is discussed, and the assignment of parities to the daughter particles is described. Selection rules are given. (J.S.R.)

1986
ON THE EQUIVALENCE OF THE PARTICLE FORMALISM AND THE WAVE FORMALISM OF MESON, II. CASE OF INTERACTING MESON AND NUCLEON FIELDS. Zensuke Tokuoka (Wakayama Univ., Japan). *Progr. Theoret. Phys.* (Japan) **10**, 137-57 (1953) Aug. (cf. Z. Tokuoka and H. Tanaka, *Progr. Theoret. Phys.* (Japan) **8**, 599 (1953)).

The β -matrix formalism is applied to the interaction of the charged meson with the nucleon. Harish-Chandra's γ formalism is used for introducing the invariant coupling terms, and the scattering matrix S is constructed covariantly by Umezawa-Takahashi's method in order to avoid the troublesome "surface terms." This S matrix contains a normal independent direct coupling of nucleons besides the usual meson-exchange couplings. It is shown that this additional coupling is due to the direct coupling included implicitly in the Lagrangian and that the possibility, stated by Klein, of canceling it by the corresponding term appearing in the whole interaction Hamiltonian is lost. The neutral and the charge-symmetrical meson are also discussed briefly. (auth)

1987
A SPECULATION ON V-SPIN. D. C. Peaslee (Columbia Univ., New York). *Progr. Theoret. Phys.* (Japan) **10**, 227-30 (1953) Aug.

A specific example is exhibited to show that it is necessary to assume complete pair production of V^0 particles in order to understand their copious production vs. slow decay in isolation. This argument can be extended to V_2^0 as well as V_1^0 . It also applies to the heavy "V fragments" recently observed, which do not seem to be compatible with the pair production hypothesis. The idea of v spin provides a convenient though not necessarily correct vehicle for the discussion. (auth)

1988
THE π -NUCLEON SCATTERING AND THE DAMPING EFFECT. Kazu Hasegawa and Shûkô Azuma (Tohoku Univ., Japan). *Progr. Theoret. Phys.* (Japan) **10**, 240-1 (1953) Aug.

Exact calculations on the π^+ - and π^- -proton elastic scatterings are compared with matrix elements based on covariant 4th-order nucleon scatterings in pseudoscalar meson theory with pseudoscalar coupling. No damping effect is noted in π^+ scattering, whereas a very large effect is indicated for π^- scattering. (K.S.)

1989
NOTE ON HARD SHOWERS. P. Van der Leeden (Bossch Laboratory for Physics, Bandung, Indonesia). *Physica* **19**, 1145-57 (1953) Dec. (In English)

The distinction between extensive and narrow showers of mesons seems to be nonessential. It reduces, in essence, to the generation of showers far away and nearby. Both types seem to be produced by the same process, i.e., catastrophic collisions, and the apparent difference is merely introduced by the particulars of the experimental coincidence technique of shower registration. It is to be expected that even this apparent difference will not be found above a height of about

4 km. For the determination of α (in the equation $N = N_0 e^{-\alpha P}$), the variation of showers generated nearby and the study of bursts seem to be the most promising methods. In all determinations of α published thus far the decrease of effective aperture of the primaries with increasing atmospheric depth has been neglected. Thus, α might well be 10% too high. The variation of hard showers generated far away, the so-called extensive ones, do not seem suitable for the determination of α . (auth)

MOLECULAR PROPERTIES

1990

Los Alamos Scientific Lab.

THE SECOND VIRIAL COEFFICIENTS OF He³ AND He⁴.

John E. Kilpatrick, Rice Inst. and William E. Keller, Edward F. Hammel, and Nicholas Metropolis, Los Alamos Scientific Lab. [1953] 28p. Contract W-7405-Eng-36. (AECU-2804)

The second virial coefficients of He³ and He⁴ have been calculated at closely spaced temperatures over the range 0.3 to 60°K, using the Lennard-Jones 12-6 potential with constants determined by de Boer and Michels. The necessary phase shifts were calculated on a high-speed electronic digital computer. The resulting He⁴ second virial coefficients agree very well with the available experimental data. They also join nicely at 60°K with the coefficients calculated from the high-temperature classical equation with quantum corrections. The second cross-virial coefficients for He³ and He⁴ were also calculated. The deviation of a gaseous solution of He³ and He⁴ from an ideal solution is comparatively small at temperatures above about 2°K, while at very low temperatures pronounced quantum solution imperfection appears. (auth)

NEUTRONS

1991

SOLUTION OF A NON-ISOTROPIC RANDOM FLIGHT PROBLEM IN THE CASE OF A NON-ISOTROPIC POINT SOURCE. C. C. Grosjean (Ryksuniversiteit Gent, Belgium). *Nuovo cimento* (9) 11, 11-40(1954) Jan. (In English)

In connection with the calculation of the perturbation caused by a thin circular detector in a thermal neutron flux, the following problem was solved. Given is a point source whose strength is described by an isotropic distribution plus a nonisotropic cosine term. The single scattering law also contains one nonisotropic term. The neutron density and the distribution of the velocity directions in every point of space were calculated, keeping the path probabilities arbitrary for the reason of generality, the exact recurrence relations between the defined probability distributions were established. By expanding these functions in series of spherical harmonics and making use of addition theorems involving Bessel functions and Legendre polynomials, it has been possible to transform the integral relations to simple linear equations. The final results are obtained in the form of integrals which can be calculated by numerical evaluation using computing machines. By introducing simplified functions under the integral signs, it is also possible to obtain good approximations for the neutron density and current. A simple example of this method is discussed in detail and the results are compared with those given by diffusion theory. (auth)

NUCLEAR PHYSICS

1992

Nuclear Physics Labs., Columbia Univ.

PROGRESS REPORT FOR JANUARY, FEBRUARY, MARCH 1953 TO THE UNITED STATES ATOMIC ENERGY COMMISSION. 38p. Contract AT(30-1) GEN-72. (CU-129)

Slow neutron transmission measurements in thick pyrex glass samples are reported. Calculations on the Doppler broadening of neutron resonance level widths have been completed. Neutron scattering data for the 16.6-ev resonance level of Ag were fitted to Breit-Wigner theory, taking into account the 5.13-ev level. All level parameters were uniquely determined. Coherent scattering cross sections have been obtained from an evaluation of the critical angles for neutron reflection of four enriched-isotope Te mirrors. The preparation of Te and liquid P neutron mirrors, for coherent scattering measurements, is described. Brief note is made of U₃O₈ plating techniques on stainless steel, the preparation of thin Cu, Ti, and Zr films, and the preparation of B(CH₃)₃ using Grignard reagent. New control circuits for the neutron velocity spectrometer have been designed. A succinic acid source of C¹⁴ was prepared for investigating the shape of the β spectrum, which was found to be straight down to 25 kev. An investigation of I¹²⁹ showed that the β spectrum end point is higher than previously reported. Electron-recoil nucleus correlations in the decay of He⁶-Li⁶ for various energies agree only with the calculated tensor curve. (For preceding period see CU-125.) (K.S.)

1993

Radiation Lab., Univ. of Calif., Berkeley

THEORY OF ALPHA DECAY OF SPHEROIDAL NUCLEI.

John O. Rasmussen, Jr. Dec. 10, 1953. 30p. Contract W-7405-eng-48. (UCRL-2431)

Various effects of spheroidal nuclear distortion on the α -decay process are considered theoretically. Differential equations governing α decay in the region beyond the maximum nuclear radius are derived. They consist of ordinary radial Schrödinger equations for α decay to various nuclear states with the addition of quadrupole interaction terms coupling the various equations. The significance of wave amplitudes of various angular momentum α groups as Fourier components of the total wave function is pointed out, and experimental α -decay-rate data for even-even nuclei are discussed in these terms. (auth)

1994

THE INTERPRETATION OF BHABHA'S THEORY OF PARTICLES OF MAXIMUM SPIN 1/2.

W. A. Hepner and D. R. Workman (Imperial Coll. of Science, London, England). *Phys. Rev.* 92, 1071-2(1953) Nov. 15.

Difficulties in the interpretation of negative probabilities have led to studies on the magnitude and behavior of reflection and transmission coefficients of Bhabha's particles at a discontinuity of the electric potential. The results of such an analysis show that in the nonrelativistic limit of particles with lower mass and small potentials, the particles behave like Dirac electrons. With no states of higher mass, this result may be extended to the relativistic region. (K.S.)

1995

THE 0⁺ STATES OF THE LIGHT ODD-ODD NUCLEI. P. Stähelin (Swiss Federal Inst. of Tech., Zürich). *Phys. Rev.* 92, 1076-7(1953) Nov. 15.

Values of the nuclear radius for K³⁸, Cl³⁴, and Al²⁶ are calculated, assuming uniform, spherical charge distribution and using empirical mass differences. The three nuclides closely fit a value of $r_0 = 1.4 \times 10^{-13}$ cm, indicating that the Coulomb energy and neutron-proton mass difference accounts for the whole energy difference between the 0⁺ states of the neighboring isobars with A = 38, 34, and 26. This result confirms the assumption of charge symmetry and charge-independent nuclear forces. The assignment of isotopic spin T = 1 to the 0⁺ states is confirmed by the constancy of log ft values. The position of the 0⁺ levels in P³⁰, Na²², and F¹⁸ is predicted on the basis of preceding results. The chart of King and Peaslee (*Phys. Rev.* 90,

1001(1953)) for the spins of light odd-odd nuclei is modified to include the new spin assignments. (K.S.)

1996

THE MECHANISM OF STRIPPING REACTIONS. J. Horowitz and A. M. L. Messiah (Centre d'Études Nucléaires de Saclay, France). *Phys. Rev.* **92**, 1326-7(1953) Dec. 1.

The theories of Daitch and French (*Phys. Rev.* **87**, 900 (1952)) and Butler (*Proc. Roy. Soc. (London)* **A208**, 559 (1951)) neglect the reaction effects of outgoing waves on the stripping process. A theory is therefore developed which takes into account the effect of the outgoing proton wave. The results and consequences of this theory are discussed. (K.S.)

1997

NUCLEAR DISINTEGRATIONS CAUSED BY 50-125 MEV PROTONS. I. P. E. Hodgson (Imperial Coll. of Science and Tech., London, England). *Phil. Mag.* (7) **44**, 1113-21(1953) Oct.

The results of measurements on nuclear disintegrations caused by 50 to 125 Mev protons in photographic emulsion are given. The relative numbers and the angular and energy distributions of the secondary α particles and protons have been found, and the collision mean free path for protons in emulsion deduced. (auth)

1998

ANGULAR DISTRIBUTION OF THE DEUTERON PHOTO-DISINTEGRATION AT MODERATE ENERGIES. Atsushi Sugie (Tokyo Univ., Japan) and Shiro Yoshida (Kyoto Univ., Japan). *Progr. Theoret. Phys. (Japan)* **10**, 236-7(1953) Aug.

Recent evidence for the existence of a relatively large isotropic part in the angular distribution of deuteron photo-disintegrations leads to a theoretical investigation of the ratio a/b , defined by $\frac{d\sigma}{d\Omega} = a + b \sin^2\theta$. The effect of the exchange moment is calculated, and it is found that a value of $a/b = 0.1$ at 20 Mev is not reasonable, indicating that the large isotropic part of the differential cross section at moderate energies cannot be accounted for by exchange moment alone. (K.S.)

1000

EFFECT OF NUCLEON EXCITED STATE ON MAGNETIC MOMENT ANOMALY. Tetuo Hamada (Hokkaido Univ., Japan). *Progr. Theoret. Phys. (Japan)* **10**, 309-22(1953) Sept.

Approximations of a nucleon in its excited state are made by a spinor field with higher mass, charge, and spin, and its effects on the anomalous magnetic moment are estimated. The result for the spin- $\frac{1}{2}$ excited state is quadratically divergent, leading to no definite conclusions. The contribution of the spin- $\frac{1}{2}$ and isotopic spin- $\frac{3}{2}$ excited state is positive for protons and negative for neutrons if this state is of a different parity from the normal state and vice versa if these are of the same parity. The absolute value is larger for protons in both cases. An additional interaction, which describes the transition of a nucleon up to or down from its excited state when it interacts with an external electromagnetic field, contributes nothing in the former choice of the parities, whereas for the latter this gives an opposite contribution to proton and neutron. The effects are, after all, not large for the reasonable choice of the coupling constant. (auth)

2000

NUCLEAR FORCES IN PSEUDOSCALAR MESON THEORY. Iwao Sato (Tohoku Univ., Japan). *Progr. Theoret. Phys. (Japan)* **10**, 323-58(1953) Sept.

Theoretical perturbation calculations are made on nuclear forces derived from pseudoscalar meson theory up to the fourth order in the coupling constant, taking into account the

recoil of the nucleons in the intermediate states. Both cases of pseudoscalar and pseudovector couplings are considered. The expressions for the nucleon-nucleon interactions obtained contain integrals of various values of nucleon momenta in the intermediate states. Expanding the integrands of these integrals in powers of μ/M , and picking up the first few terms from each of these expansions, the nuclear potentials are obtained for the case in which the nucleon recoil is neglected. These potentials are found to be in agreement with the adiabatic potentials which have been calculated by Taketani et al. for the case of pseudovector coupling and by Lévy and Klein for the case of pseudoscalar coupling. However, the differences between the adiabatic potentials and the potentials calculated by taking account of the nucleon recoil are found to be much larger than those expected by considering them to be of the higher order in μ/M . Brief discussions are made on the qualitative properties of the calculated nucleon-nucleon interactions. (auth)

2001

NEW PROPOSAL ON THE MASS SPECTRUM OF ELEMENTARY PARTICLES. S. Yoshikawa and T. Hasebe (Hitachi Manuf. Co., Ltd., Katsuta-machi, Ibaragiken, Japan). *Progr. Theoret. Phys. (Japan)* **10**, 359-61(1953) Sept.

Nambu's mass spectrum (*Progr. Theoret. Phys. (Japan)* **7**, 595(1952)) $\mu_n = 137n$ is revised to the form $\mu_n = m_0\omega^n$, and the results are found to agree closely with measured mass values of known elementary particles. The significance of the constants is discussed. (K.S.)

NUCLEAR PROPERTIES

2002

THE MAGNETIC MOMENTS OF SPIN $\frac{1}{2}$ NUCLEI. R. J. Blin-Stoyle (Clarendon Lab., Oxford, England). *Proc. Phys. Soc. (London)* **A66**, 1158-61(1953) Dec. 1.

It is shown that the deviations of the magnetic moments of all spin- $\frac{1}{2}$ nuclei from the Schmidt limits can be adequately accounted for by simple interconfigurational mixing. (auth)

2003

TOTAL CROSS SECTIONS FOR 169-MEV NEUTRONS. A. E. Taylor (Univ. Uppsala, Sweden). *Phys. Rev.* **92**, 1071(1953) Nov. 15.

Total cross sections of H, H-D, C, and O have been experimentally determined for 169-Mev neutrons. (K.S.)

2004

NUCLEAR SPIN OF Bi^{210} . Mark Fred, Frank S. Tomkins, and Raymond F. Barnes (Argonne National Lab., Lemont, Ill.). (*Phys. Rev.* **92**, 1324-5(1953) Dec. 1.

The Bi I resonance line of Bi^{209} , $\lambda 3067$, has been resolved as a doublet with upper-state splitting of 0.828 cm^{-1} . For Bi^{210} , $\lambda 3067$ was found to be a single sharp line. Although the upper-limit separation of hfs in this line would be 0.1 of the width of the Bi^{210} line, it is thought probable that no splitting is present and that $I = 0$. Hence, the 127th neutron is considered to be in the $g_{7/2}$ state. The isotopic shift of the Bi^{210} line was found to be 0.12 cm^{-1} to the shorter wavelengths. (K.S.)

2005

ENERGY LEVELS OF Be^8 . R. Malm and D. R. Inglis (Argonne National Lab., Lemont, Ill.). *Phys. Rev.* **92**, 1326(1953) Dec. 1.

The region of excitation energy from 0 to 7 Mev has been investigated for Be^8 by observing the α groups from the $\text{B}^{11}(\text{p}, \alpha)\text{Be}^8$ reaction. Only the prominent peaks of the ground state and 29 Mev appeared. (K.S.)

2006

THE ENERGY LEVELS OF Be^{10} . K. B. Rhodes and J. N. McGruer (Univ. of Pittsburgh). *Phys. Rev.* **92**, 1328-9 (1953) Dec. 1.

The proton spectrum of Be^{10} has been investigated by analysis of the $\text{Be}^9(d,p)\text{Be}^{10}$ reaction, using 14.5-Mev deuterons. An energy-level diagram is given, together with a table of level values for the 5.94- and 6.24-Mev energies at various laboratory angles. (K.S.)

2007

ON THE REACTION $^{18}\text{O}(p,\alpha)^{15}\text{N}$. R. R. Roy, A. Lagasse, and M. J. Decock (Université Libre de Bruxelles, Belgium). *Phil. Mag.* (7)44, 1189-91(1953) Oct.

The possible existence of low-lying excited levels in N^{15} , using the $\text{O}^{18}(p,\alpha)\text{N}^{15}$ reaction with proton energies up to 700 kev, has been investigated. It is concluded that no excited level is formed in N^{15} at the resonant proton energy of 640 kev and that the compound nucleus F^{19} decays with the emission of one group of α particles, leaving the final N^{15} nucleus in the ground state. (K.S.)

2008

PROBLEM OF THE CROSS SECTIONS OF INTERACTION OF SUPERFAST NUCLEONS. E. L. Feinberg and D. S. Chernavskii. *Doklady Akad. Nauk S.S.S.R.* 91, 511-13(1953) July 21. (In Russian)

The Heisenberg theory that meson production is a shock wave problem is declared incorrect. It is concluded that the divergence of computations of cross sections of superfast nucleons by classical and quantum methods has its origin in Heisenberg's neglect of uncertainty relations. (J.S.R.)

2009

PURPOSE OF A STATISTICAL MODEL WITH INDEPENDENT PARTICLES OF A HEAVY NUCLEUS. A. Kind and G. Patergnani (Univ. of Padua, Italy). *Nuovo cimento* (9) 11, 106-7(1954) Jan. (In Italian). (cf. NSA 8-1203)

With the statistical model it is possible, by calculation of the mean free path of a nucleon in nuclear matter, to determine the configuration of the nucleus and to deduce, by quantization corrections, the probability of transition. (J.S.R.)

2010

THE QUADRUPOLE MOMENTS OF NUCLEI ACCORDING TO THE SPHEROIDAL NUCLEAR MODEL. II. R. Van Wageningen (Rijks-Universiteit, Groningen, Netherlands). *Physica* 19, 1004-10(1953) Oct. (In English) (cf. NSA 6-5663)

The energy of a spheroidal nucleus is calculated as a function of the eccentricity. The linear term in the eccentricity is independent of the form of the potential and proportional to the kinetic energy of the last nucleon (or hole) for a (closed shells ± 1 nucleon)-nucleus for various nuclear models. The amount of the quadratic term depends strongly on the nuclear model and is rather uncertain. Therefore in calculating the quadrupole moment one can more safely use the semiempirical mass formula. For nuclei with more than one extra nucleon, a combination of jj-coupling and collective model is proposed in view of the empirical data on quadrupole moments. (auth)

2011

FORMATION AND RADIATIONS OF GERMANIUM 67. A. H. W. Aten, Jr., T. de Vries-Hamerling, and L. Lindner (Instituut voor Kernfysisch Onderzoek, Amsterdam, Netherlands). *Physica* 19, 1046(1953) Oct. (In English)

Ge^{67} was prepared in the cyclotron by the reactions $\text{Zn}^{64}(\alpha,n)\text{Ge}^{67}$ and $\text{Zn}^{66}(\alpha,3n)\text{Ge}^{67}$. The Ge fraction was isolated by repeated distillation as the tetrachloride and showed a strong β^+ period of 19 min. The maximum β^+ energy was measured as 3.4 ± 0.3 Mev. Measurements with a scintillation detector indicated the occurrence of a 0.17 ± 0.01 -Mev γ ray. (J.S.R.)

2012

THE SHORT-LIVED NEUTRON-DEFICIENT ISOTOPE OF

SELENIUM. F. N. Hooge and A. H. W. Aten, Jr. (Instituut voor Kernfysisch Onderzoek, Amsterdam, Netherlands). *Physica* 19, 1047-8(1953) Oct. (In English)

A Se isotope in low yield was obtained by the $\text{Ge}^{70}(\alpha,n)$ reaction. A weak β^+ period of 44 min was observed, but as the intensity did not decrease as the energy of the He ions decreased, the isotope was not Se^{70} . The maximum β^+ energy was calculated to be 1.7 ± 0.2 Mev. It is suggested that the isotope is probably Se^{73} or Se^{75} , although the decay does not follow the one postulated for either of these isotopes. (J.S.R.)

NUCLEAR REACTORS

2013

STUDY OF THE MULTIPLICATION FACTOR IN THE SACLAY PILE. B. Jacrot, F. Netter, and V. Raieviski (Commissariat à l'Énergie Atomique, Saclay, France). *J. phys. radium, phys. appl.* 15, 31A-38A(1954) Jan. (In French)

Some methods have been studied for the measurement of the effective multiplication factor in a pile from experiences in subcritical operation. These methods are applied to the determination of the effect on the reactivity of different parameters of the pile such as the level of the heavy water or position of the control plates. These results are used to establish an experimental relationship between the time of the rise of the pile and the effective multiplication factor. The application of these methods to an evaluation of the power of the pile is given. (tr-auth)

2014

MEASUREMENT OF THE AVERAGE LIFE OF NEUTRONS IN A HEAVY WATER PILE WITH A REFLECTOR AND A NEW DETERMINATION OF THE REACTIVITY. Victor Raieviski. *Compt. rend.* 237, 1513-15(1953) Dec. 9. (In French)

The phase and modulation amplitude of the neutron density is measured by periodic variations of a pile, giving an average neutron life in the pile and the amplitude of the reactivity. The results are in agreement with values calculated by the Nordheim equation. Kinetic equations are unable to account for the experimental results. (tr-auth)

NUCLEAR TRANSFORMATION

2015

TWO-NUCLEON NUCLEAR TRANSITIONS. L. A. Sliv and L. K. Peker. Translated from *Doklady Akad. Nauk S.S.S.R.* 92, 277-9(1953). 3p. (NSF-tr-188)

An abstract of this paper appears in *Nuclear Science Abstracts* as NSA 8-1213.

2016

LOW INTENSITY LINES IN THE SPECTRUM OF THE GAMMA-RAYS FROM $^7\text{Li}(p,\gamma)^8\text{Be}(\alpha)^4\text{He}$. E. K. Inall and A. J. F. Boyle (Australian National Univ., Canberra). *Phil. Mag.* (7)44, 1081-90(1953) Oct.

Evidence for a γ -ray line at about 12.5 Mev, in the $\text{Li}^7(p,\gamma)$ spectrum has been put forward recently by several workers. Although the measurements differ amongst themselves, it appears that a line is present to about 10% of the intensity of the well known 17.6-Mev component. Experiments have shown that, in addition to the broad 14.8-Mev line, there are other transitions from the 17.6-Mev state of Be^8 to lower even states. The results were obtained by observing the emitted γ -ray coincidence with one of the α particles resulting from the breakup of the even state. The measured α -particle ranges show that transitions occur to Be^8 levels at 4.09, 5.31 ± 0.06 , and 7.51 ± 0.06 Mev. The corresponding γ rays have energies of 13.54, 12.32 ± 0.06 , and 10.12 ± 0.06 Mev and intensities of 2, 2, and 0.5% of the total intensity. Backgrounds of soft x radiation from the

target backing and energetic α particles from the reaction $\text{Li}^7(p,\alpha)\text{He}^4$ complicated the experiment, necessitating the performance of check experiments to ensure correct interpretation of the results. In particular the time of flight of the α particles was used to give a rough indication of their energy and demonstrate the reliability of the coincidence counting. (auth)

- 2017
SPALLATION OF VANADIUM, MANGANESE, AND COBALT WITH 187 MEV PROTONS. S. G. Rudstam (Univ. of Uppsala, Sweden). *Phil. Mag.* (7)44, 1131-44(1953) Oct.

Measurements of the yield of various spallation products from V, Mn, and Co are described. From the experiments it is concluded that in the spallation of medium-weight elements with high-energy protons, the total cross section per mass number decreases almost exponentially with increase in the difference between the actual mass number and the mass number of the target nucleus. It is also concluded that for a given mass number the cross sections of the isobars are approximately represented by a Gaussian distribution. (auth)

- 2018
DETERMINATION OF THE WIDTHS OF THE LEVELS OF P^{31} FROM THE REACTION $^{27}\text{Al}(\alpha,p)^{30}\text{Si}$. R. R. Roy and C. Godeau (Université Libre de Bruxelles, Belgium). *Phil. Mag.* (7)44, 1184-6(1953) Oct.

The widths of α resonance levels for the compound nucleus produced by α bombardment of Al^{27} have been experimentally determined. Measurements have been confined to E_α energies of 4.0 and 4.4 Mev, for the group Q = -1.32 Mev. Values of 0.36 ± 0.06 and 0.30 ± 0.06 Mev, respectively, are reported. (K.S.)

- 2019
THE CROSS SECTION FOR $^{181}\text{Ta}(\gamma,n)^{180}\text{Ta}$ AT 17.6 MEV. J. H. Carver and H. J. Hay (Australian National Univ., Canberra). *Phil. Mag.* (7)44, 1191-3(1953) Oct.
The ratio of the $\text{Ta}^{181}(\gamma,n)\text{Ta}^{180}$ cross section at 17.6 and 14.6 Mev was found to be 0.26 ± 0.06 , in good agreement with previous work. A $\text{Li}^7(p,\gamma)$ reaction was used as a source of γ radiation. (K.S.)

- 2020
THE REACTION $^{13}\text{C}(\alpha n)^{16}\text{O}$. G. A. Jones and D. H. Wilkinson (Cavendish Lab., Cambridge, England). *Proc. Phys. Soc. (London)* A66, 1176-9(1953) Dec.

The thin target excitation function of the $\text{C}^{13}(\alpha,n)\text{O}^{16}$ reaction is investigated between 1 and 2 Mev. (K.S.)

- 2021
EXCITATION CURVE FOR A $(d,\alpha 2n)$ REACTION ON Ag. L. Th. M. Ornstein, R. E. W. Kropveld, and A. H. Wapstra (Instituut voor Kernfysisch Onderzoek, Amsterdam, Netherlands). *Physica* 19, 915-18(1953) Oct. (In England)
The excitation curves for the reactions $\text{Ag}^{109}(d,2p)\text{Cd}^{108}$ and $\text{Ag}^{107}(d,\alpha 2n)\text{Pd}^{108}$ have been measured by stacked foil techniques. (auth)

RADIATION ABSORPTION AND SCATTERING

- 2022
Los Alamos Scientific Lab.
ELASTIC SCATTERING OF PIONS BY NUCLEONS AND PION PRODUCTION IN NUCLEON NUCLEON COLLISIONS. John L. Gammel. [1953]. 29p. Contract W-7405-eng-36. (AECU-2801)

If the ideas about the pion-nucleon interaction discussed by Chew (*Phys. Rev.* 89, 591(1953)) are taken seriously, it is important to know the accuracy of his calculation of the phase shifts for pion-nucleon scattering resulting from the second-order Tamm-Dancoff approximation. Exact solutions (found by numerical methods) of the integral equations for the scattering amplitudes resulting from the second-order

Tamm-Dancoff approximations are compared with his approximate results. Aitken, Mahmond, and Watson have shown that a similar integral equation occurs in a theory (based on the same ideas as those discussed by Chew) of pion production in nucleon collisions. The accuracy of their approximate solution of this integral equation is discussed. (auth)

- 2023
Knolls Atomic Power Lab.
NUCLEAR SCATTERING OF HIGH-ENERGY ELECTRONS. J. H. Smith. [1954] 21p. Contract W-31-109-Eng-52. (AECU-2805)

The Born approximation is used to calculate matrix elements for the elastic and inelastic scattering of high-energy electrons by nuclei. Curves and simple numerical relations are given to describe the manner in which scattered amplitudes depend upon nuclear characteristics. (auth)

- 2024
Atomic Energy Research Establishment, Harwell, Berks (England)
THE THERMAL NEUTRON TRANSPORT PARAMETERS IN WATER. J. P. Elliott. Oct. 1953. 15p. (AERE-T/M-91)

An attempt is made to establish consistency between the cross section data and the transport parameters for thermal neutrons in water. The mean cosine of the scattering angle is calculated for a bound proton to deduce $l_{tr}(v)$ from the known $l_{sc}(v)$. The correct manner of averaging over the Maxwell energy distribution is discussed. The appropriate average values of l_{tr} and L do not agree with the experimental data although the data are still uncertain. Interference between the scattered waves from the two protons is the most likely cause of this difference. It seems probable that agreement will be obtained when this effect is taken into account and a reliable experiment is made to determine L and l_{tr} . (auth)

- 2025
Nevis Cyclotron Labs., Columbia Univ.
SCATTERING OF 65 MEV PIONS IN HYDROGEN. D. Bodansky, A. M. Sachs, and J. Steinberger. Nov. 1953. 45p. Contract N6-ori-110, Task 1. (NEVIS-1)
A measurement has been made, at approximately 65 Mev, of the differential cross sections in the processes $\pi^+ + p \rightarrow \pi^+ + p$, $\pi^- + p \rightarrow \pi^- + p$, and $\pi^- + p \rightarrow \pi^0 + n$ using a liquid H target and scintillation counter detectors. Because of coulomb interference effects, the experiment, in principle, affords the opportunity of determining the signs as well as the magnitudes of the phase shifts in an analysis including only S-1 and p-waves. It is found that two very markedly different sets of phase shifts fit the data. Each of these sets includes subsets of the Fermi and Yang type. The results of this experiment, in conjunction with those of similar experiments, somewhat favor a set characterized by a strong attractive p-wave interaction in the $T = 3/2$ isotopic spin state. (auth)

- 2026
Radiation Lab., Univ. of Calif., Berkeley
PROTON-PROTON SCATTERING AT 9.7 MEV. Bruce Cork and Walter Hartsough. Oct. 30, 1953. 17p. Contract W-7405-eng-48. (UCRL-2373)

The differential cross section for scattering of 9.7-Mev protons from H_2 has been measured. Angles over the range from 27 to 112° in the center-of-mass system have been measured with a statistical error of less than $\pm 1.0\%$, and a probable error of $\pm 1.1\%$ has been assigned to the absolute values of differential cross section. It is observed that within the accuracy of the measured cross section, the scattering can be described as pure S wave. (auth)

2027

Radiation Lab., Univ. of Calif., Berkeley
ON THE LOW-ENERGY PION-NUCLEON INTERACTION
(thesis). O. Heinz. Nov. 1953. 45p. Contract W-7405-eng-48. (UCRL-2423)

The production cross section for positive pions produced at 0° to the 339-Mev proton beam in the reaction $p + p \rightarrow \pi^+ + p + n$ was measured at several energies in the neighborhood of 21.5-Mev pion energy. A pion leaving the target with this energy has the same velocity as a nucleon also leaving the target at 0° . A strong pion-nucleon interaction at low relative energies could then produce an appreciable effect on the shape of the pion spectrum. Measurements of the relative and of the absolute production cross section were made. No appreciable rise was observed in the relative cross section in this region, and the absolute value was found to be in agreement with the values obtained by earlier experiments. (auth)

2028

Radiation Lab., Univ. of Calif., Berkeley
TOTAL CROSS SECTIONS FOR P-P SCATTERING AT 330 AND 225 MEV. O. Chamberlain, G. Pettengill, E. Segrè, and C. Wiegand. Jan. 14, 1954. 5p. Contract W-7405-eng-48. (UCRL-2460)

The total cross sections for scattering of high-energy protons by protons have been directly measured at the full and at one reduced energy of the Berkeley synchrocyclotron. Attenuation of the external beam in liquid H was measured with standard counting techniques in order to check, by an independent method, the results obtained in previous differential-scattering experiments. (auth)

2029

PHASE-SHIFT CALCULATION OF HIGH-ENERGY ELECTRON SCATTERING BY NUCLEI. D. R. Yennie, R. N. Wilson, and D. G. Ravenhall (Stanford Univ., Stanford, Calif.). *Phys. Rev.* **92**, 1325-6(1953) Dec. 1.

The accuracy of the Born approximation for predicting the scattering of high-energy electrons in heavy nuclei is examined. The results of phase-shift calculations are given for Au, assuming both a uniform and exponential charge distribution. For comparison, the calculation was also carried out for Cu, using the uniform distribution. The cross section for Cu was found to agree more closely with the Born approximation than that for Au. The cross sections given by both charge distributions are found to decrease in about the same ratio between 30° and 90° , with a value roughly given by Hofstadter, et al. (*Phys. Rev.* **92**, 978(1953)). (K.S.)

2030

NUCLEAR CONFIGURATIONS INFERRED FROM HIGH-ENERGY PICKUP-DEUTERON DISTRIBUTIONS. W. Selove (Harvard Univ., Cambridge, Mass.). *Phys. Rev.* **92**, 1328 (1953) Dec. 1.

Nucleon momentum distributions within nuclei were investigated by determining pickup-deuteron cross sections in C, Al, and Si from a 95-Mev cyclotron proton beam. It is shown that only one type of neutron state in C enters into the pickup process, giving strong evidence for an α -particle structure. Strong peaks are less pronounced in the heavier nuclei, and for the case of Si^{28} the results are interpreted to show that the neutron distribution in the ground state is affected by the removal of one proton. An α -particle structure is also associated with Si^{28} . (K.S.)

2031

SCATTERING OF NEUTRONS WITH ENERGY TO SOME DEGREE IN LIQUID HELIUM II. I. M. Khalatnikov and V. N. Zharkov. *Doklady Akad. Nauk S.S.S.R.* **93**, 799-802(1953) Dec. 11. (In Russian)

The scattering of neutrons in He II by rotons and phonons

was investigated. The energy of the neutron scattering is used to derive equations for the number of rotons and phonons present in a unit volume of He II. The ranges of neutrons with energy $\theta = 2^\circ\text{K}$ and for different temperatures of He II are tabulated. (J.S.R.)

2032

THE CONVERGENCE OF THE BORN APPROXIMATION METHOD. P. Urban (Universität Graz, Austria) and K. Wildermuth (Max-Planck-Institut für Physik, Göttingen, Germany). *Z. Naturforsch.* **a8**, 594-8(1953) Oct. (In German)

On the basis of a single example, the convergence of the Born method for the treatment of scattering problems dependent on scattering potential and mass energy was investigated. (tr-auth)

2033

THE MULTIPLE SCATTERING OF 7.5 MEV DEUTERONS IN METALS. A. Ashmore and A. V. Crewe (Univ. of Liverpool, England). *Proc. Phys. Soc. (London)* **A66**, 1172-5(1953) Dec.

Measurements have been made of the multiple scattering of 7.5-Mev deuterons in a range of metallic elements from Al to Au. Satisfactory agreement was obtained between the experimental distributions and those calculated from Molière's theory. The heavy elements do not show discrepancies similar to those observed in the multiple scattering of electrons and μ mesons with relativistic velocities in Pb. (auth)

RADIATION EFFECTS

2034

Bausch and Lomb Optical Co.
SOME EXPERIMENTS ON THE INTERACTION OF GLASS WITH HIGH ENERGY RADIATION. Norbert J. Kreidl. Dec. 1, 1953. 19p. Contract AT(30-1)-1312. (NYO-3779)

Atomic Energy processes and materials are observed visually or microscopically through glass which is specified for transparency, persistence of transparency, and sometimes shielding power. The mechanism of discoloration and its prevention are the subjects of exploratory work of theoretical as well as practical interest. Bleaching rates indicate complex processes related to F-center formation in simple crystals. Cerium prevents discoloration like that by sunlight in certain glasses. Optical glass, reasonably persistent in transparency in certain ranges of intensity, is now available. The sensitivity to γ radiation, especially of Ag glasses, suggests their use for quantitative measurement. Shielding against γ rays is, in practice, limited to Pb glass. Neutron interactions are more complicated and specific; Cd borate glass was investigated as a prototype. (auth)

*2035

Radiation Lab., Univ. of Calif., Livermore
SPUTTERING OF STAINLESS STEEL BY PROTONS IN THE 30-80 KEV RANGE. Forrest Fairbrother, Jr. and John S. Foster, Jr. Aug. 11, 1953. 12p. Contract W-7405-eng-48. (UCRL-4169)

A preliminary survey into the sputtering rates for protons bombarding stainless steel in the 30- to 80-kev range was made experimentally. Results show a sputtered atom to incident ion ratio of 0.16×10^{-2} to 2.0×10^{-2} . (auth)

2036

THE CROSSLINKING OF RUBBER BY PILE RADIATION. Arthur Charlesby (Atomic Energy Research Establishment, Harwell, Berks, England). *Atomics* **5**, No. 1, 12-21, 27 (1954) Jan.

Rubber becomes crosslinked when subjected to high-

energy radiation such as is present in reactors. This offers a means of studying the change in properties of rubber as the degree of crosslinking is varied without the use of chemical vulcanizing agents. The efficiency of crosslinking, the variation of the gel fraction, and molecular weight of gel and sol fractions are studied. A mathematical analysis is given of the variation with crosslinking index γ of the gel fraction, the average molecular weight of the sol fraction, and the crosslinking of the gel. The results obtained also apply to other long-chain polymers whose molecular weight follows a random probability (Poisson) distribution. From swelling measurements it is shown that the degree of crosslinking is directly proportional to radiation dose, unit radiation dose producing one crosslink per 90 isoprene units. This is confirmed by elastic measurements on irradiated rubber. The observed variation in the gel fraction with radiation dose follows that predicted by theory, assuming an initial Poisson distribution of molecular weight, modified by a small degree of crosslinking. The average molecular weight M_0 can be deduced from the radiation dose required to initiate gel formation and from the variation of gel fraction with radiation dose. Measurements based on the viscosity of the sol fraction lead to similar values of M_0 but are less reliable because of the uncertain relation between viscosity and molecular weight. The Flory-Huggins swelling relationship has been investigated for very lightly crosslinked gels, and the validity of certain corrections studied. The crosslinking efficiency for rubber is compared with that of certain other long-chain polymers. (auth)

2037

PARAMAGNETIC RESONANCES IN IRRADIATED GLASSES. E. L. Yasaitis and B. Smaller (Argonne National Lab., Lemont, Ill.). *Phys. Rev.* **92**, 1068-9(1953) Nov. 15.

Paramagnetic resonances have been detected in glasses which had been exposed to γ radiation. The experimental data were taken over a frequency range of 18 to 375 Mc/sec. The equipment used was $\frac{1}{4}$ - λ coaxial line regenerative detector developed for the 100- to 375-Mc/sec frequency range, while the 18- to 100-Mc/sec range was covered by a cathode-above-ground regenerative detector with conventional tank coil wound around the sample. Both circuits were used in conjunction with a dual field modulation technique designed for previous experiments. The detection limit was 2×10^{14} spins, requiring a 10^3 -r exposure. The free radical diphenylpicryl-hydrazyl was used both for intensity and field calibration. (auth)

RADIOACTIVITY

2038

THE DECAY OF CALCIUM 47. A. H. W. Aten, Jr., E. Greuell, and W. J. Van Dijk (Instituut voor Kernfysisch Onderzoek, Amsterdam, Netherlands). *Physica* **19**, 1049-50(1953) Oct. (In English)

Ca^{47} was prepared by the $\text{Ti}^{50}(\text{d}, \text{ap})$ reaction and isolated by repeated precipitations. The γ rays, observed with a scintillation counter, had an energy of 1.3 ± 0.2 Mev. Absorption measurements in Al were made on the β rays, and two absorption curves with $E_{\text{max}} = 0.8 \pm 0.2$ Mev were found. It was concluded that Ca^{47} emits β particles with energy of 2.0 ± 0.2 Mev in a process leading to the ground state of Sc^{47} and β particles with an energy of 0.8 ± 0.2 Mev (3.4 ± 1 times as many β particles in the latter process as in the former) leading to an excited state of Sc^{47} lying 1.3 ± 0.2 Mev above the ground state. (J.S.R.)

2039

THE DECAY OF VANADIUM 47 AND MANGANESE 51. A. H. W. Aten, Jr., J. Kooi, B. De Vries, and A. L. Veenendaal (Instituut voor Kernfysisch Onderzoek,

Amsterdam, Netherlands). *Physica* **19**, 1051-2(1953) Oct. (In English)

The decay of V^{47} was observed with a β counter, a γ counter, and a scintillation counter. It was concluded that the larger part (probably at least 80%) of the β^+ emission processes in V^{47} lead directly to the ground state of Ti^{47} , and no occurrence of γ rays was found in appreciable quantities. Observations were made of Mn^{51} with a scintillation counter only. No evidence of γ decay was found. (J.S.R.)

2040

DIRECTIONAL CORRELATION OF TWO SUCCESSIVE RADIATIONS EMITTED BY ORIENTED NUCLEI. J. A. M. Cox and H. A. Tolhoek (Univ., Leiden, Netherlands). *Physica* **19**, 1178-86(1953) Dec. (In English)

The correlation probability $W(k_1, k_2, \eta)$ for the directions k_1 and k_2 of two radiations emitted in cascade by an ensemble of oriented nuclei is calculated. The unit vector η is an axis of rotational symmetry along which the nuclei are oriented. The result is specialized for the case of γ - γ correlations. For two dipole transitions $j \rightarrow j-1 \rightarrow j-2$ and for two quadrupole transitions $j \rightarrow j-2 \rightarrow j-4$ explicit formulas are given, which are suitable for direct evaluation. (auth)

2041

BETA-GAMMA COINCIDENCES IN THE UX-SPECTRUM. E. F. de Haan, G. J. Sizoo, and P. Kramer (Vrije Univ., Amsterdam, Netherlands). *Physica* **19**, 1201-4(1953) Dec. (In English)

Measurements were made of the β - γ coincidences in the UX complex ($\text{UX}_1 + \text{UX}_2 + \text{UZ}$). The coincidence spectrum was composed of three components with end points at 100, 600, and 1500 kev. The intensity of the 100-kev component was of the same order as that of the 1500-kev component. Some conversion peaks were found in the spectrum, and their energies and probable γ assignments are tabulated. A decay scheme is proposed, and the relative intensities of the β radiations were calculated. (J.S.R.)

2042

THE ELECTRON SPECTRUM OF ^{234}U . Ong Ping Hok and G. J. Sizoo (Vrije Univ., Amsterdam, Netherlands). *Physica* **19**, 1205-7(1953) Dec. (In English)

The electron spectrum of Pa^{234} was measured in a double-focusing β spectrometer. The spectrum had 34 conversion lines, and their energies and probable γ assignments are tabulated. A proposed decay scheme is given. (J.S.R.)

2043

ON THE THEORY OF BETA-DECAY. Yasutaka Tanikawa and Keiiti Saeki (Kobe Univ., Japan). *Progr. Theoret. Phys. (Japan)* **10**, 233-4(1953) Aug.

A theory of β decay is formulated upon the postulates that (1) primary interactions between nucleons, leptons, and bosons are renormalizable and (2) the resulting matrix elements give rise to transitions of the Fermi and Gamow-Teller type which are about the same order of ratio. It is assumed that as sources of a Bose field, there exists a pairing of nucleon and lepton. The resulting interactions are renormalizable. (K.S.)

2044

NOTE ON THE FINITE NUCLEAR SIZE EFFECT IN BETA-DECAY. Masami Yamada (Tokyo Univ., Japan). *Progr. Theoret. Phys. (Japan)* **10**, 241-3(1953) Aug.

Consequences on β -decay mechanisms due to the effect of nuclear size are considered. As previously suggested (Rose and Holmes, *Phys. Rev.* **83**, 190(1951)) the eigenfunctions of the electron on a finite nuclear surface are different than those for the case of the point charge. This approach is compared to the case of β -decay theory where some arbitrariness is introduced on the behavior of the

eigenfunction, particularly when large cancellations of correction-factor terms occur. (K.S.)

2045

CORRECTION TO THE BETA-DECAY NUCLEAR MATRIX ELEMENTS. Masami Yamada (Tokyo Univ., Japan). *Progr. Theoret. Phys. (Japan)* **10**, 245-51(1953) Sept.

In the traditional theory of β decay, the radial parts of the eigenfunctions of the electron which are divided by r^l (l 's are orbital angular momenta) are put out of the integral symbols, replacing r by ρ (nuclear radius), and the remaining integrals are arranged as nuclear matrix elements. In the presence of the coulomb field, however, some of them appreciably deviate from constants in the nucleus, and it is hard to put them out of the integrals. The correction factors which include these eigenfunctions in the integral symbols are given, and it is discussed how the difference from the old theory is produced. (auth)

2046

THEORETICAL REINVESTIGATION OF THE β -SPECTRUM OF RaE. Masami Yamada (Tokyo Univ., Japan). *Progr. Theoret. Phys. (Japan)* **10**, 252-64(1953) Sept.

The β spectrum of Bi^{210} is reinvestigated, taking into account the finite de Broglie wavelength effect pointed out by Rose et al., and the correction to the nuclear matrix elements pointed out by the author. It is shown that the conclusion of Petschek and Marshak concerning the assumption of tensor + pseudoscalar, spin change 0-0, parity change yes, is unable to explain the experimental results. Taking into account the above two effects, many other assumptions can explain the experiments. The results are as follows: TP0-0 (tensor + pseudoscalar and spin change 0-0), ST1-0, and VA1-0 fit the experiments only with the finite de Broglie wavelength effect, A0-0 (including AP0-0) and VT1-0 requires both effects, but VT1-0 seems too artificial. Other cases cannot fit the experiments. (auth)

2047

ON THE INTERACTION FORMS OF THE BETA-DECAY. Yasutaka Tanikawa (Kobe Univ., Japan). *Progr. Theoret. Phys. (Japan)* **10**, 361-2(1953) Sept.

Two new forms of the primary β interactions are derived from results previously considered (*Progr. Theoret. Phys. (Japan)* **10**, 232(1953)). Transformation under space inversion of fermion wave functions yields a β -decay Hamiltonian which just corresponds to a definite combination of Yang-Tiomno direct interactions ($S' - T' + P'$). (K.S.)

2048

INTERFERENCE TERMS OF β -RAY ANGULAR CORRELATIONS. Masato Morita (Tokyo Univ., Japan). *Progr. Theoret. Phys. (Japan)* **10**, 363-4(1953) Sept.

A table of interference terms between different β -ray angular distribution functions is presented. The interaction Hamiltonian is assumed to be a linear combination of $G_S S$, $G_V V$, $G_T T$, $G_A A$, and $G_P P$. (K.S.)

2049

POSSIBLE $0 \rightarrow 0$ (NO) β TRANSITIONS IN $4n + 2$ NUCLEI. O. Kofoed-Hansen (Univ. of Copenhagen, Denmark). *Phys. Rev.* **92**, 1075-6(1953) Nov. 15.

A curve of $E_{T=1} - E_{T=0}$ against mass number for $6 < A < 38$ is given. The curve shows that in Cl^{34} the $T = 1$ state lies below the $T = 0$ state. The closed shell 2×8 shows up as a peak. A table of expected maximum values of E_β and half life t is presented for $A = 4n + 2$, $18 \leq A \leq 58$. An $f t$ value of 2700 is calculated. (K.S.)

2050

THE β SPECTRUM OF RaD. E. Huster (Univ. of Marburg/Lahn, Germany). *Phys. Rev.* **92**, 1076(1953) Nov. 15.

The β spectrum of Pb^{210} was investigated for the purpose of determining how the energy excess ΔE_x between parent and daughter atom is carried away. Assuming that the β

particle carries ΔE_x , a spectrum cutoff at 16 kev would be expected in Pb^{210} . No such cutoff was observed, indicating that ΔE_x is shared between electron and neutrino. Discrepancies between the obtained spectrum shape and that due to Jaffe and Cohen (*Phys. Rev.* **89**, 454(1953)) are discussed. (K.S.)

2051

THE RENORMALIZED SINGLE-TIME BETHE-SALPETER EQUATION. K. Symanzik (Max Planck Institut für Physik, Göttingen, Germany). *Nuovo cimento* (9) **11**, 88-91(1954) Jan. (In German)

The single-time integral of the Bethe-Salpeter equation is shown graphically, as well as the equalization of time and the positive frequency part of the equation. It is concluded that the modifications of the equation offer no advantage over the original. (J.S.R.)

2052

PRECISE DETERMINATION OF THE ENERGY OF α RAYS EMITTED BY THORIUM. Georges Philbert, Jeannine Génin, and Léopold Vigneron (College of France, Paris). *J. phys. radium* **15**, 16-20(1954) Jan. (In French)

The α paths from Th, Th^{230} , and Po introduced in an emulsion were measured and compared with a path-energy calculated curve. Chemical and other precautions prevented any difficulty from the radioactive products of Th. The residual energy of the α emitted by Th^{232} is 3.990 ± 0.020 Mev, and, if one considers a 75-kev difference between the two α rays, as determined by Mlle Albouy (*J. phys. radium* **13**, 309(1953)), the α rays have the energy 4.008 ± 0.020 Mev for the principal ray and 3.933 ± 0.020 Mev for the secondary ray. (tr-auth)

2053

ON THE RADIATIONS EMITTED IN THE COURSE OF THE TRANSMUTATION $\text{Rac} \rightarrow \text{AcX}$. Marcel Frilley, Salomon Rosenblum, Manuel Valadares, and Georges Bouissieres (Lab. Curie, Paris, France, and Lab. du Grand Aimant Permanent, Bellevue, France). *J. phys. radium* **15**, 45-9 (1954) Jan. (In French)

A critical study of the data on the fine α structure, on the γ spectrum of diffraction, and on the magnetic spectrum of the conversion electrons of Rac leads to a new interpretation for the region of γ emissions lower than 100 kev. This interpretation, based on the most recent calculations concerning the internal conversion, is controlled by means of new precise measurements of the conversion spectrum, made with a source of very pure Rac. A satisfactory agreement is obtained between the proposed hypothesis and the experimental results. (J.S.R.)

2054

PARTICLES WITH LONG PATH EMITTED FROM SOURCES OF POLONIUM. Marie Ader (College de France, Paris). *J. phys. radium* **15**, 60(1954) Jan. (In French)

The origin of particles with long path emitted from Po is uncertain. It was thought that the particles could be caused by the action of the α rays of Po on the H_2 of the air, the H_2 of the source support, or the humidity retained in the source. However, the 5.2-Mev α ray can project in a hydrogenated substance protons of only 80 μ , and paths longer than 300 μ were observed. The type of source support did not change the number of long paths. It was suggested that perhaps a spontaneous emission of the nuclei of a Po atom occurred. (J.S.R.)

2055

ON THE DECAY OF Po^{210} . Radha Raman Roy and Marie-Louise Goes. *Compt. rend.* **237**, 1515-17(1953) Dec. 9. (In French)

Experiments are described for testing a theory due to Migdal concerning the origin of soft 84-kev radiation emitted by the α decay of Po^{210} to Pb^{206} . Although accurate

agreement was not obtained (within an order of magnitude) between the Migdal prediction and experiment, it is concluded that the observed level is due to the ionization of the atom following α decay according to a Migdal process. (K.S.)

SPECTROSCOPY

2056

Ames Lab.

THE EFFECT OF STRAY LIGHT IN PRISM AND GRATING SPECTROGRAPHS ON EMULSION CALIBRATION CURVES AND ITS SIGNIFICANCE IN SPECTROGRAPHIC ANALYSIS. Richard N. Kniseley and Velmer A. Fassel. Jan. 4, 1954. 19p. Contract W-7405-eng-82. (ISC-435)

Several investigators have observed that emulsion calibration curves obtained from spectrograms exposed in Littrow-mounting prism spectrographs exhibit a smaller slope than the corresponding curves obtained from spectrograms exposed in Wadsworth-mounting grating spectrographs. A study of the nature of this difference has shown that stray light originating from direct reflection and lens flare at the collimating-camera lens in the Littrow prism spectrograph is responsible. Since the magnitude of the integrated stray light radiation falling on any area of the emulsion is dependent on the number and proximity of exposures, the slope of the emulsion calibration curves obtained from Littrow spectrograph exposures may change with placement on the plate, unless focal-plane diaphragming is employed. The significance of this stray-light factor in spectrographic analysis and in relative-intensity measurements is discussed. (auth)

2057

ON THE THEORY OF THE FINE STRUCTURE OF THE X-RAY ABSORPTION SPECTRA OF IONS IN SOLUTIONS. E. E. [Ye.] Vainshtein. Translated from Doklady Akad. Nauk S.S.S.R. 91, 1059-62(1953). 4p. (NSF-tr-168)

The structure of the x-ray absorption spectra of ions in solution is calculated according to the formula $\Gamma = \Delta + k\Gamma_0$, where Γ is the experimentally observed width of the line in the absorption spectrum, Γ_0 is the width of the initial level of transition, k is a coefficient varying from 0 to 1 and dependent on the ratio Δ/Γ_0 or Γ_0/Γ , and Δ is the quantity of the Stark effect. The experimental values for Zn in water and methanol are compared with the theoretical values. In all cases the theoretical and experimental curves are similar, and for aqueous solutions they are identical. (J.S.R.)

2058

REDISTRIBUTION OF THE INTENSITIES OF SPECTRAL LINES OF ELEMENTS IN A DISCHARGE IN ARGON. K. N. Mochalov and E. [Ye.] L. Raff. Translated from Doklady Akad. Nauk S.S.S.R. 91, 1067-70(1953). 4p. (NSF-tr-174)

A study was made of the spectra of metals and alloys during their excitation in an atmosphere of A. An a-c arc was used as a source. The metallic electrodes were enclosed in a vertical quartz tube, through which an atmosphere of pure A was admitted. (J.E.D.)

2059

ON THE EFFECT OF THE HYDROGEN BOND ON RAMAN SPECTRUM. A. I. Stekhanov. Translated from Doklady Akad. Nauk S.S.S.R. 92, 281-4(1953). 4p. (NSF-tr-189)

An investigation of the H bond in crystals of gypsum was made for the purpose of studying the intensity distribution in the region of valence vibrations of the HO bond depending on the temperature. Experimental results indicate that the fine structure of the HO bond observed in the Raman spectrum in gypsum crystals is caused by a coupling between the intramolecular vibrations of the HO group and the intermolecular vibrations. (J.E.D.)

2060

THE ISOTOPIC DISPLACEMENT IN THE SPECTRUM OF ARGON. Horst Meyer (Universität Zürich und Universität de Genève, Switzerland). *Helv. Phys. Acta* 26, 811-20(1953) Dec. 15. (In German)

The isotopic displacements in the emission spectrum A I and A II of A^{36} , A^{38} , and A^{40} were measured on the separated isotopes with the aid of Pérot-Fabry etalons. The results for the A I spectrum were compared with those of Kopfermann. The displacements in the A II spectrum were discussed. A^{38} , as expected and as A^{36} and A^{40} , possesses no magnetic nuclear moment. (tr-auth)

THEORETICAL PHYSICS

2061

ON THE QUANTUM THEORY OF WAVE FIELDS. B. T. Geilikman. Translated from Doklady Akad. Nauk S.S.S.R. 90, 359-62(1953). 5p. (NSF-tr-190)

An abstract of this paper appears in *Nuclear Science Abstracts* as NSA 7-5452.

2062

DERIVATION AND RENORMALIZATION OF THE TAMM-DANCOFF EQUATIONS. Behram Kursunoglu (Cornell Univ., Ithaca, N. Y.). *Phys. Rev.* 92, 1069-70(1953) Nov. 15.

It is shown that the derivation of Tamm-Dancoff equations for two nucleons (as well as for meson-nucleon scattering) from the covariant Bethe-Salpeter equation can be simplified to a remarkable degree, and the renormalization in the Tamm-Dancoff method can be achieved in a covariant manner without having the difficulties presented by the original Tamm-Dancoff method. (auth)

2063

THE SINGLE-TIME BETHE-SALPETER EQUATION. Wilhelm Macke (Instituto de Fisica Teórica, Sao Paulo, Brazil). *Phys. Rev.* 92, 1072(1953) Nov. 15.

Modifications of the Tamm-Dancoff method for two-particle interaction in bound states, proposed by Dyson (*Phys. Rev.* 90, 994(1953)), yield the equation $(W - E_N + E_N') a(N', N) = \langle \Psi_0, [C(N') A(N), H'] \Psi \rangle$. It is noted that $a(0, 2)$ is the single-time form of the Bethe-Salpeter wave function for two particles in positive free-energy states and that the wave equation can be given by $a(0, 2) = f a(0, 2)$, where f is an integral operator. Since $\Psi_0 = P \exp(-i \int_{-\infty}^0 H' dt) \phi_0$, it also follows that $a(0, 2) = g a(2)$. (K.S.)

2064

SOLUTION OF THE WAVE EQUATION NEAR AN EXTREMUM OF THE POTENTIAL. Charles J. Mullin (Univ. of Notre Dame, Notre Dame, Ind.). *Phys. Rev.* 92, 1323-4(1953) Dec. 1.

Accurate one-dimensional solutions of the wave equation $d^2\psi/dy^2 + a^2[\epsilon + P(y)]\psi = 0$ are obtained over an extended range of y , consistent with retaining all powers through y^6 in the expansion of the potential in the vicinity of the extremum. It is noted that the one-valued solutions, $\psi_1 = P^{-1/4} Z^{1/4} D_n(\xi)$, $\psi_2 = P^{-1/4} Z^{1/4} D_{-n-1}(\xi)$, are good approximations to the solutions of the wave equation near $y = 0$. (K.S.)

2065

EQUIVALENT MASS AND OTHER EFFECTS OF A NON-LOCAL ELECTROMAGNETIC FIELD IN INTERACTION WITH A CONSTANT E, H FIELD. Christopher Gregory (Univ. of Hawaii, Honolulu). *Phys. Rev.* 92, 1554-7(1953) Dec. 15.

Some consequences of the interaction of a nonlocal photon with a constant E, H field are considered. The interaction is shown to vanish in the limit of local fields independently of the magnitude of the coupling constant g , so that results obtained could be traced directly to the assumption of a

nonlocal field. An exact solution for the nonlocal field is obtained as a sum of a nonlocal plane waves containing the four-vector q_μ . It is shown that this four-vector in conjunction with the coupling constant plays two roles. In one it is involved in the expression for an electric dipole moment: $g\bar{q}$ and in the other in an expression for a magnetic dipole with moment: $g/2(\bar{q} \times \bar{k})/|k|$, where $\bar{k}/|k|$ is the propagation vector. This identification gives significance to the C numbers, q_a , appearing in the theory. The equivalent mass μ , averaged over orientations of \bar{q} for which $\mu^2 > 0$, turns out to be of order $4.0 \times 10^{-12}(\gamma B/\lambda)^{1/2}$ electron masses, where γ is the number of Bohr magnetons; $|g\bar{q}|mc/\hbar$, λ is the wavelength, and B is an upper limit to the magnitude of the external field in Gaussian units. An order-of-magnitude measure of the optical properties of the region containing the constant E, H field which affects the nonlocal photon is $|n-1| = 3.2 \times 10^{-4}(\lambda\gamma B)$, where n is an upper limit to the index of refraction. For pronounced measurable effects $|n-1| \approx 0.1$ implies that $\langle\mu\rangle/m$ attains a value of $10^{-10}/\lambda$ electron mass. (auth)

2066

A NOTE ON THE QUANTUM DYNAMICAL PRINCIPLE. Julian Schwinger (Harvard Univ., Cambridge, Mass.). *Phil. Mag.* (7)44, 1171-9(1953) Oct.

It is shown that commutation relations are derived consistently from the quantum dynamical principle for systems obeying first-order equations of motion. (auth)

2067

SCHWINGER'S DYNAMICAL PRINCIPLE. W. K. Burton (Univ. of Glasgow, Scotland) and B. F. Touschek (Universita degli Studi, Rome, Italy). *Phil. Mag.* (7)44, 1180-1(1953) Oct.

A comparison is made of the methods applied by Schwinger and by the authors to the derivation of commutation relations for systems whose equations of motion are of the first order in the time derivatives. (auth)

2068

ON THE STATISTICAL MECHANICS OF MATTER IN AN ELECTROMAGNETIC FIELD. I. DERIVATION OF THE MAXWELL EQUATIONS FROM ELECTRON THEORY. P. Mazur and B. R. A. Nijboer (Instituut voor Theoretische Natuurkunde, Utrecht, Netherlands). *Physica* 19, 971-86 (1953) Oct. (In English)

Maxwell's macroscopic field equations are derived from the fundamental microscopic equations of electron theory in a new way. Instead of the usual space-time averaging procedure, a statistical ensemble averaging method is applied, which is perhaps more satisfactory both from a physical and from a mathematical point of view. The treatment is valid for multicomponent systems, in which every component may move in an arbitrary way, so that diffusion phenomena are included. Furthermore, it would seem that the method given here is also suitable for the discussion of other problems connected with the behavior of matter in an electromagnetic field. (auth)

2069

RELATIONS IN THE SECOND QUANTIZATION. WAVE MECHANICS IN THE CONFIGURATION SPACE AND THE PROBLEMS OF THE SECOND ORDER IN CALCULATION OF PROBABILITIES. Georges Bodiou (Faculté des Sciences de Marseille, France). *J. phys. radium* 15, 39-44(1954) Jan. (In French)

The actual mathematical state of the second quantization is not satisfactory. Operators of annihilation η and of emission η^+ were introduced without defining the mathematical individuals on which they operate. The Fock operators for the harmonic oscillator or the operator $\partial/\partial\eta$, though incorrectly operating on functions of an integral number, cannot be considered as constructions of η (or of η^+), but as

examples proving that the rules of commutation imposed on η and η^+ are not contradictory. The fact that there exists another formalism (which is called the configurative formalism) for the treatment of systems of particles poses a question of coherence and a question of relative extension for this formalism and the second quantization. The fact that the problems of uncertain distribution of an ensemble of objects are classical in the calculation of probabilities under the name of problems of the second order incites a comparison of their classical treatment with that which the second quantization applies to these problems. The object of this article is to examine these diverse questions in the case of bosons. (tr-auth)

2070

A SOUND-WAVE DESCRIPTION OF FERMION ASSEMBLIES. M. R. Schafroth (Univ. of Liverpool, England). *Nuovo cimento* (9) 11, 53-72(1954) Jan. (In English)

A description of assemblies of noninteracting fermions in terms of sound-waves is given. Additional degrees of freedom are needed for a complete determination of the system, but their contributions are expected to be small for all isotropic excitations. Special magnetic fields can also be included. The thermodynamic functions are calculated, and an application to the problem of density fluctuations is sketched. (auth)

2071

THE IMPOSSIBILITY OF DECOMPOSING THE WAVE FUNCTION $\psi(M_1, \dots, M_1, \dots, M_N)$ OF A COLLECTION OF FERMIONS M_i INTO A PRODUCT OF INDIVIDUAL WAVE FUNCTIONS $\psi_i(M_i)$. Georges Bodiou. *Compt. rend.* 257, 1493-5 (1953) Dec. 9. (In French)

The state of a collection of N particles is described by a wave ψ , a complex function of the coordinates of the N particles $\psi(x_1, y_1, z_1; \dots; x_N, y_N, z_N) = \psi(M_1, \dots, M_N) = \psi(P)$, where P is a point having coordinates x_1, \dots, z_N , in a 3-dimensional space, called a configuration space (\mathcal{C}). This wave is assumed normal to (\mathcal{C}). It is known that satisfying the Pauli exclusion principle imposes the condition of antisymmetry on the wave $\psi(P)$, in relation to the particles M_i whose coordinates are their arguments. If the function $\psi(P)$ is decomposable to the form

$$\psi(P) = \prod_{i=1}^{i=N} \psi_i(M_i) = \psi_1(M_1) + \dots + \psi_i(M_i) + \dots + \psi_N(M_N),$$

it is immediately evident that $\psi_i(M) + \psi_j(M)$, otherwise the antisymmetry of $\psi(P)$ for the permutation of M_i and M_j will not be compatible except for $\psi(P) = 0$. It is shown that the antisymmetry is incompatible with the proposed decomposition, even if all of the individual wave functions $\psi_i(M)$ are different. (tr-auth)

2072

COVARIANT FOURIER INTEGRALS AND SOLUTION OF THE CAUCHY PROBLEM FOR FREE PARTICLES OF SPIN $1/2$ AND 1. Olivier Costa de Beauregard. *Compt. rend.* 257, 1495-7(1953) Dec. 9. (In French)

A reciprocal equation previously developed (*Compt. rend.* 232, 804(1951)) is corrected and extended to include a covariant formulation due to Riesz and Schwinger. (K.S.)

2073

RELATIVISTIC TWO BODY PROBLEM OF QUANTUM MECHANICS. I. Wilhelm Macke (Instituto de Física Teórica, São Paulo, Brazil). *Z. Naturforsch.* a8, 599-615 (1953) Oct. (In German)

The general Bethe-Salpeter equation to describe the bound state between two particles was converted to a four-component, noncovariant equation by a transition to a single-time description and evaluation of all time variables. The resultant equation agrees with the Tamm-Dancoff-Lévy

equation up to a characteristic difference in the reciprocal action operator \bar{V} of the equation. (tr-auth)

2074

THE RELATIVISTIC TWO BODY PROBLEM OF QUANTUM MECHANICS. II. Wilhelm Macke (Instituto de Física Teórica, São Paulo, Brazil). *Z. Naturforsch.* **a8**, 615-20 (1953) Oct. (In German)

The four-component wave equation to describe the bound state of two particles was investigated and converted by an arbitrary transformation into new constructions. It is shown that two known constructions of this equation may be obtained. One of the constructions was derived by the Tamm-Dancoff-Lévy equation from a single-time construction of the field theory. The other was determined in Part I and derived from the Bethe-Salpeter equation. (tr-auth)

2075

NON-LOCAL FIELD THEORY ON THE BASIS OF THE SALPETER-BETHE EQUATION. I. "FREE" PARTICLES. Hermann L. Jordan and Wilhelm E. Frahn (Technischen Hochschule, Aachen, Germany). *Z. Naturforsch.* **a8**, 620-7 (1953) Oct. (In German)

In the limits of the relativistic two body problems described by the Salpeter-Bethe equation, the conception of free particles as a suitable limiting case was interpreted and the problem of the single irreducible fourth-order graph discussed. Conclusions were drawn from the general single-particle problem with total reciprocal action. For the "free" particles defined in the above manner, one obtains a generalized Dirac equation with structure function, which makes possible a formulation of the mass problems of elementary particles. The equation agrees in its form with the single-particle equation which follows from the nonlocal field theory. (tr-auth)

2076

ON THE CONSTANTS OF MOTION FOR THE CASE OF NON-LOCALIZED INTERACTIONS. Yôrô Ôno (Hokkaido Univ., Japan). *Progr. Theoret. Phys. (Japan)* **10**, 125-36 (1953) Aug.

By generalizing the method formerly developed by the author (*Progr. Theoret. Phys. (Japan)* **6**, 925(1951)), the energy-momentum tensor is obtained for the case of nonlocalized interactions. It is found that the interaction part of this tensor is not given simply by $-L'/4\pi\nu$ and that the total tensor satisfies the equation of continuity as a consequence of the equations of motion. As the result of the space integration of the μ^4 component of the tensor, a general and simple expression of the energy-momentum 4-vector is derived in terms of δ functions and sign functions of the time. This vector turns out to be the constant of motion, owing to the continuity equation. The same is true of the case of current density and total charge. Thus, it may be asserted, contrary to the opinion of Kristensen-Møller and Bloch (*Det. Danske Vid. Selske* **27**, No. 7(1952)), that it is always possible to construct not only the constants of collision but also the constants of motion when the invariant Lagrangian is given. The problem is now to consider the physical significance of the expressions and how to perform the quantization upon Heisenberg representation. (auth)

2077

MISCELLANEA IN ELEMENTARY QUANTUM MECHANICS. III. UNCERTAINTY RELATIONS AND GROUND STATES. Kôji Husimi and Masuhiko Ôtuka (Osaka Univ., Japan). *Progr. Theoret. Phys. (Japan)* **10**, 173-90(1953) Aug.

On the ground that there exists an intimate correlation between the uncertainty relation and the ground state of a quantum-mechanical system, variants of the usual uncertainty relation and a method of determining the ground states for a number of systems are presented. The arguments may be applied also to excited states. (auth)

2078

ON GAUGE INVARIANCE IN ELECTRODYNAMICS AND THE SELF-ENERGY PROBLEM OF THE PHOTON. Osamu Hara and Hisaichiro Okonogi (Nagoya Univ., Japan). *Progr. Theoret. Phys. (Japan)* **10**, 191-8(1953) Aug. (cf. NSA 7-3972)

The physical meaning implied in the gauge invariance of electrodynamics is analyzed using the Hamiltonian formalism. The self-energy of the photon is calculated as a limit of diminishing the rest mass of the self-energy of a neutral vector quantum with small rest mass to zero. The inevitability of introducing the method of renormalizing the light velocity, as proposed in a previous paper (*Progr. Theoret. Phys. (Japan)* **8**, 265(1952)), is concluded from these results. (auth)

2079

ON THE EFFECTS OF EXCITED STATES OF NUCLEONS UPON STATIC NUCLEAR POTENTIAL IN SYMMETRICAL PSEUDOSCALAR MESON THEORY. I. DERIVATION OF NUCLEAR POTENTIAL AND QUALITATIVE CONCLUSIONS. Tokuji Matsumoto, Tetuo Hamada and Masao Sugawara (Hokkaido Univ., Japan). *Progr. Theoret. Phys. (Japan)* **10**, 199-226(1953) Aug.

The effects of excited states of nucleons upon static nuclear potential in symmetrical pseudoscalar meson theory are investigated. An additional interaction Hamiltonian is introduced, according to which a nucleon can make a transition from its ground states to the excited one of both spin and isotopic spin $\frac{1}{2}$, or vice versa. The fourth-order perturbation contribution of this Hamiltonian is calculated in the nonrelativistic and static approximations for nucleons. The effects of excited states prove to be very large. The derived nuclear potential contains generally a very strong attractive central force and a very small tensor force of various signs, both of which have very high singularities at the origin. The most interesting feature is that the effects are much larger for charge triplet states than for charge singlet states. The derived nuclear potentials are summarized in the final section with five qualitative conclusions. The quantitative investigations of the potentials derived will be given in detail in the subsequent paper. (auth)

2080

ON THE SOLUTION OF THE EQUATION OF MOTION. Hideji Kita (Kyoto Univ., Japan). *Progr. Theoret. Phys. (Japan)* **10**, 231-2(1953) Aug.

The equations of motion for quantum electrodynamic fields are written in integral form. Some considerations connected with this approach are noted. (K.S.)

2081

ON THE NUCLEAR SATURATION. Syûzô Ogawa and Toshio Marumori (Nagoya Univ., Japan). *Progr. Theoret. Phys. (Japan)* **10**, 265-74(1953) Sept.

The Tamm-Dancoff method is applied to the bound system of many particles, with the viewpoint of meson theory. The results seriously modify the usual method in which the many-body problem is treated with the simple addition of the two-body potential. It is shown that this modification has a possibility of giving the nuclear saturation. (auth)

2082

SPIN-SPIN AND SPIN-OTHER-ORBIT INTERACTIONS. Hisashi Horie (Univ. of Tokyo, Japan). *Progr. Theoret. Phys. (Japan)* **10**, 296-308(1953) Sept.

Spin-spin and spin-other-orbit interactions are re-written in terms of the products of tensor operators, and the method of Racah is applied. The procedure has some advantages from the formal and practical point of view. For example, the conjugation process can be carried out only after the decomposition of the spin-other-orbit operator into this form. It was confirmed that the magnetic interaction parameters are proportional to Z^3 , Z being the atomic number. (auth)

